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ABSTRACT

This plan plots the course for meeting educational needs in Texas through such technologies as computer-based systems, devices for storage and retrieval of massive amounts of information, telecommunications for audio, video, and information sharing, and other electronic media devised by the year 2000 that can help meet the instructional and productivity needs of public education. First, the economic status of the state is outlined, a rationale for the incorporation of technology into the schools is given, and the potential benefits of technology and its expected impact on teaching, learning, curriculum, management, and facilities are reviewed. Objectives and requirements are presented in tabular form for student workstations, teacher workstation modules, administrator workstations, open-access learning centers, and telecommunications centers. An action plan for technology integration is then described which focuses on the priority areas of classroom instruction, instructional management, distance learning, and communications. Implementation of the plan is discussed in terms of hardware procurement and purchase, courseware adoption and provision, training and certification of teachers, instructional delivery systems, and research and development. Calendars are also provided for three phases of implementation--1988-89 through 1991-92; 1992-93 through 1995-96; and 1996-97 through 1999-2000. Budget requests to the state legislature for incorporating technology into public education complete the main body of the report. A four-page reference list is included. (GL)

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# 1988-2000 LONG-RANGE PLAN FOR TECHNOLOGY OF THE TEXAS STATE BOARD OF EDUCATION

TEXAS EDUCATION AGENCY
AUSTIN, TEXAS

IR013858

DECEMBER 1988

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# LONG-RANGE PLAN FOR TECHNOLOGY OF THE TEXAS STATE BOARD OF EDUCATION 1988 - 2000

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December 1988

To Members of the Legislature and the Citizens of Texas:

Charged with the responsibility and the privilege of implementing the requirements of House Bill 72, the appointed State Board of Education has overseen the forging of significant reforms in education in Texas.

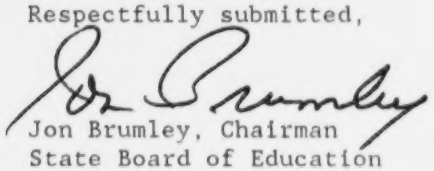
In reviewing its accomplishments during the past four years, the members of the board are particularly proud of the plans for the future that we impart to our successors. Foremost among these are the *Long-Range Plan of the State Board of Education for Texas Public Schools, 1986-1990*, *Career Opportunities in Texas: A Master Plan for Vocational Education*, and this *Long-Range Plan for Technology of the Texas State Board of Education, 1988-2000*. These plans present a vision and a means for accomplishing equity and excellence in Texas education.

Developed over 18 months with assistance from numerous advisers, consultants, and reviewers, this *Long-Range Plan for Technology* meets legislative mandates for such a plan, Texas Education Code 14.021, and addresses both economic and educational needs that can be met through technology. These needs include the fact that the Texas economy is changing from one based on oil and gas, manufacturing, and agriculture to one based on information and other services. Despite the demand for workers who are accomplished in the tools of the future, Texas currently ranks last among the 15 most populous states in expenditures for technology programs. As a result, we fail to use technology to provide equitable and adequate curriculum, professional staff development, technology, and access to information and communications among its school districts.

With authorization and appropriation from the legislature, with attention by the Texas Education Agency to the actions stipulated to be undertaken by educational entities, and with oversight by the board to ensure accountability for the expected outcomes, this plan promises to carry forward to the 21st century the reforms initiated by the Texas Legislature in 1984. The outcomes envisioned through implementation of the plan include equity in curriculum offerings and quality, consistent and high-quality inservice, efficient communications, comprehensive use of technology in all appropriate areas of education, reduced teacher paperwork, and lower administrative costs.

The State Board of Education appreciates the support it has received from the Texas Legislature to improve education for the children of Texas and looks forward to continuing to serve the economic well-being of the state through implementing this *Long-Range Plan for Technology of the Texas State Board of Education, 1988-2000.*

Respectfully submitted,



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Rensselaer-Columbia-Greene Board of Cooperative Education Services

Minnesota Department of Education

Bloomington (Minnesota) Public Schools

Robbinsdale (Minnesota) Technology Learning Centers

Minnesota Educational Computing Corporation

California Department of Education

Columbus (Ohio) Public Schools

Cypress-Fairbanks (Texas) Independent School District

Eula (Texas) Independent School District

Judson (Texas) Independent School District

Texas Association of Community Schools

Texas Association of School Administrators

Texas Classroom Teachers Association

Texas Elementary Principals and Supervisors Association

Sheppard Air Force Base

Apple Computer Corporation

Staff also acknowledges the contributions of the students enrolled in the Policy Research Project "Education, Technology, and the Texas Economy" at the LBJ School of Public Affairs, 1987-88.

## Chronology of the Development of the Long-Range Plan for Technology

In addition to consultations with experts in educational uses of technology and visits to sites in Texas and other states that illustrate exemplary uses of technology, the following key events mark the development of this plan.

| | |
|---|---|
| January 10, 1987 | State Board of Education: Approval to Develop the Long-Range Plan for Technology |
| June 13, 1987 | Committee for Long-Range Planning: Timetable for Developing the Plan |
| July 10, 1987 | Committee for Long-Range Planning: Consultation on Technology Promises and Problems |
| September 11, 1987 | Committee for Long-Range Planning: Approval of the Commissioner's Advisory Committee on the Long-Range Plan for Technology |
| October 14-15, 1987 | Site visit by Dr. Emmett Conrad to the New York State Department of Education |
| October 30, 1987 | Committee for Long-Range Planning Workday: Report by Coopers and Lybrand and Presentations by Vendors |
| November 13, 1987 | Committee for Long-Range Planning: Workplan |
| November 20, 1987 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Charge to the Committee and Issues |
| December 9, 1987 | State Board of Education Workday on the Long-Range Plan for Technology: Efforts in Other States |
| January 5, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Rationale and Assumptions |
| January 8, 1988 | Committee for Long-Range Planning: Rationale and Assumptions |
| February 5, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Technology Forecast and Governance |
| February 13, 1988 | Committee for Long-Range Planning: Technology Forecast and Governance |

*(Chronology, continued)*

| | |
|---|---|
| March 10, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Standards |
| March 12, 1988 | Committee for Long-Range Planning: Standards |
| April 7, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Research and Development |
| April 9, 1988 | Committee for Long-Range Planning: Research and Development |
| May 10, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Proposed Legislation |
| June 11, 1988 | Committee for Long-Range Planning: Proposed Legislation |
| June 13, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Outline and Preliminary Draft Plan |
| June 29, 1988 | State Board of Education Workday: Proposed Budgets |
| July 9, 1988 | Committee for Long-Range Planning: Proposed Budget |
| July 26, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Proposed Budget |
| September 10, 1988 | Committee for Long-Range Planning: Draft Plan |
| October 4, 1988 | Commissioner's Advisory Committee on the Long-Range Plan for Technology: Draft Plan |
| October 7, 1988 | Committee for Long-Range Planning and Committee of the Whole: Revised Plan |
| November 11, 1988 | Committee of the Whole: Presentation of the Plan<br>Committee for Long-Range Planning: Approval of the Plan |
| November 12, 1988 | State Board of Education: Adoption of the Long-Range Plan for Technology of the Texas State Board of Education, 1988-2000 |

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# LONG-RANGE PLAN FOR TECHNOLOGY OF THE TEXAS STATE BOARD OF EDUCATION 1988 - 2000

## Summary

This *Long-Range Plan for Technology of the Texas State Board of Education* plots the course for meeting educational needs through technology and for implementing concomitant changes in education from 1988 to 2000. Both technology and the field of education are fluid; applying advances in the former to the practice of the latter can help achieve a vision of education that has been as yet unattainable.

### The Vision

The education system that the State Board of Education envisions is one in which:

- No student would be denied, by virtue of district sparseness or teacher shortage, course work necessary for employment or higher education.
- Teachers can have both the responsibility and the technical resources to guide the instruction of their students in the most appropriate and efficient ways.
- Performance, not processes, can determine advancement.
- Performance and socioeconomic status are unrelated.
- Adults can continually enhance their job and life skills.

### Definition and Priorities

The technologies encompassed in this plan that can help achieve this vision are computer-based systems, devices for storage and retrieval of massive amounts of information, telecommunications for audio, video, and information sharing, and other electronic media devised by the Year 2000 that can help meet the instructional and productivity needs of public education. This plan focuses on the priority areas of:

- classroom instruction
- instructional management
- distance learning
- communications.

This plan complements the *Texas Education Agency Information Systems Long-Range Plan* which addresses the automation requirements for the agency from 1988 through 1993.

### The Needs

Multiple needs support the implementation of this long-range plan for educational uses of technology. In addition to the realization of the board's vision of education, these needs include:

- the demands of the state's economy

- legislative mandates
- the *Long-Range Plan of the State Board of Education for Texas Public School Education, 1986-1990.*

The traditional sectors on which the Texas economy has relied—oil and gas production, manufacturing, and agriculture—are shriveling in comparison to expansion in the service sector.

- Between 1982 and 1987, employment in the first of these areas fell over 40 percent.
- The service sector is projected to generate nearly 70 percent of total job growth by 2000; a 44-percent increase is projected in computer and data processing services alone.

These employment shifts have profound implications for education, for the jobs of the future will belong to the educated. Insufficient education and resources threaten quality of life, individual earning power, and the state's fiscal health, producing multiple social and economic repercussions.

Legislative mandates include:

- Chapter 14 of the Texas Education Code which stipulates action regarding software approval and access and a long-range plan for instructional uses of technology
- Texas Education Code Section 11.33(b)(1) which requires financial assistance for computer services offered by regional education service centers
- Vernon's Texas Civil Statutes Article 4413(32h), Section 2.08 which authorizes the Information Systems Long-Range Plan.

Finally, the mission of quality, equity, and accountability of the State Board of Education as stated in its *Long-Range Plan* and actions stipulated in that plan necessitate technology. Although narrowing, a gap in achievement exists between minority and non-minority students and between performance of Texas students and their national counterparts. In addition, as illustrated by a drop between 1982-83 and 1986-87 of 41 percent in the number of initial teacher certificates issued by the state, teacher shortages are potentially severe. These problems indicate the need to address quality in the education system.

The attainment of equity also is compromised through the imbalance in course offerings across the state.

- While the largest districts in the state offer an average of over 200 courses each, the smallest offer approximately one-quarter as many.
- Districts with a low percentage of low-income students offer an average of 20 percent more courses than do those with a high percentage of low-income students.

With technology, population density need not determine curriculum richness.

Technology can also improve accountability through increasing information sharing while reducing paperwork burdens.

- Up to 50 percent of teachers' time is spent on nonteaching tasks.
- Over 60 percent of teachers report that time-consuming paperwork tasks have increased in the past five years.

## The Successes of Technology

Although no single solution can meet all of these needs, technology has been shown to contribute significantly to overcoming them. Research shows:

- Instructional television can increase student achievement.
- Computer-assisted instruction (CAI) can improve basic skills acquisition by approximately 10 percentile points.
- CAI has contributed to a rise in higher-order thinking skills of at-risk students of up to 25 percentile points.
- Adaptive/assistive devices can increase attention span, retention, and problem-solving skills of special education students.
- Distance learning is a proven means for providing effective instruction and inservice.
- A fully implemented statewide telecommunications system can save a projected $2 million annually.

## The Applications of Technology

With the application of current and emerging technologies to education, students can work at their own pace, following the learning style most appropriate to their needs and skills and accessing libraries of information. Teachers' workstations can be multimedia productivity centers from which teachers can present visual and sound demonstrations, monitor individual student progress, and complete formerly tedious paperwork automatically. Administrators can review and aggregate data on achievement, teacher assessments, expenditures, and inventories and communicate rapidly with other education institutions. Entire communities can be served by campus learning centers where adults can improve their literacy and job skills.

## The Actors and The Actions

In order to realize the vision and meet economic, legislative, and educational needs, coordinated effort is necessary—by all levels of the public education system, by developers and vendors of current and emerging technologies and of the software and courseware that make them useful, by researchers who investigate and report on successes and inefficiencies, by institutions of higher education that prepare teachers for tomorrow's classrooms, and by communities and the state that must support and will benefit from citizens who are skilled and self-reliant. This plan helps coordinate the necessary actions by these participants.

The calendar for implementing the plan is divided into three phases of four years each. Key actions by the state during Phase 1 (1988-89 through 1991-92) include:

- Authorize expenditures and other legislative changes for implementation of the plan.

- Establish a technology equipment allotment within the Foundation School Program of at least $50 per student per year on an equalized basis for district hardware and courseware and facility modification.
- Reinstate support for instructional television.
- Establish a statewide electronic information transfer system.
- Establish a research and development consortium and demonstration programs.
- Expand distance learning by building on available services, including public broadcasting and other providers.
- Assist districts with selecting and acquiring equipment through revising arrangements with the State Purchasing and General Services Commission.
- Incorporate courseware adoption into the textbook adoption process.
- Revise curriculum rules.
- Support teacher and administrator training in and by technology.
- Establish quality, technical, functional, security, service, and other standards for equipment, courseware, and training through a State Board of Education Advisory Committee on Technology Standards.

Key actions by regional education service centers emphasize:

- Establish Technology Preview Centers.
- Include in core services training and other assistance to districts in technology selection and use.
- Employ at least 1 full-time equivalent at each regional education service center to perform these functions.

Key actions by districts during Phase 1 include:

- Prepare annual district and campus plans for technology.
- Provide training to staff in appropriate uses of technology.
- Provide incentives for staff to use technology.
- Procure and integrate hardware and software according to local plans and State Board of Education Equipment Targets.
- Use integrated telecommunications systems for instruction, inservice, and information sharing.
- Participate in demonstration programs.

Institutions of higher education are called on to incorporate technology in undergraduate and graduate instruction and training and to conduct and disseminate research in educational uses of technology. The consortium will, during Phase 1, initiate research projects for value-added development and marketing by member companies of educational applications of technology. Actions by these entities during the subsequent two phases pursue those initiated in the first phase to reach the following cumulative outcomes. Interim outcomes of actions are stated in the calendar.

## Cumulative Outcomes

Procedural and interim outcomes will take place during the early phases. By 2000, the cumulative outcomes are expected to include:

- Technology and its applications in education will be distributed equitably and sufficiently throughout Texas.
- Statewide integrated telecommunications systems will be established.
- Professional staff employed in and entering public education will be skilled in using technology for instruction and management.
- Effective integration of technology in education will continually increase.
- Applications for education of emerging technology that meet state standards will be developed and marketed at competitive prices.
- A Long-Range Plan for Technology for the first decade of the 21st century will be prepared for implementation.

## The Budget 1990-91 Biennium

The appropriation requested to initiate implementation of the plan during the first biennium is $16.65 million.

# LONG-RANGE PLAN FOR TECHNOLOGY OF THE TEXAS STATE BOARD OF EDUCATION 1988 - 2000

## Background

This *Long-Range Plan for Technology of the Texas State Board of Education* was developed during 1987 and 1988 under the direction of the board in response to pressing economic, legislative, and educational needs. The Commissioner's Advisory Committee on the Long-Range Plan for Technology and state and national experts in the applications of technology to education contributed critical technical and instructional guidance. Their varied perspectives enriched the planning process and immeasurably strengthened the plan. These advisors and the diverse affiliations which they represent are acknowledged above.

The technologies encompassed in the plan are computer-based systems, devices for storage and retrieval of massive amounts of information, telecommunications for audio, video, and information sharing, and other electronic media devised by the Year 2000 that can help meet the instructional and productivity needs of public education. This plan focuses on four priorities:

- classroom instruction
- instructional management
- distance learning
- communications.

The *Long-Range Plan for Technology of the Texas State Board of Education* is based on principles regarding education and technology to which the State Board of Education is committed. These principles include:

- Technology must be infused into instruction: technology is, by definition, a tool.
- Technology is one of many vehicles that must work in concert with one another for improving education.
- Districts and campuses must be accorded flexibility in selecting technologies and applications to meet local needs while being held accountable for continual improvement in achievement and productivity.
- State and local governments must provide incentives for technology acquisition and implementation.
- Teachers are essential for high-quality education.
- Staff training is critical to successful integration of technology.
- Future decisions must be based on the results of research.
- Technology changes rapidly and unpredictably, and technology changes the settings into which it is incorporated. The plan, therefore, is flexible in the long term, able to incorporate a variety of technologies and to take advantage of the multi-vendor environment. The education system must also be flexible, able to revise assumptions as technology contributes to changing the current educational environment.

In keeping with the priorities and these principles, the purposes of this Long-Range Plan for Technology are to:

- Improve learning and teaching and the ability to meet individual students' needs in order to increase student achievement.
- Improve curriculum delivery in order to help meet the needs for educational equity across the state.
- Improve inservice delivery.
- Improve the efficiency and productivity of administrators.
- Encourage development by the private sector and acquisition by districts of technologies and applications appropriate for education.

# I. THE LONG-RANGE PLAN FOR TECHNOLOGY IS IMPERATIVE

A variety of reasons compel the adoption and implementation of this *Long-Range Plan for Technology.* These reasons include social and economic forces in the state and nation, legislative mandates, the board's own *Long-Range Plan for Public School Education,* and, above all, the education system and benefits to the state and its citizens that can accrue from the implementation of this plan.

## A. The Texas Economy Demands an Educated Workforce

### 1. Education, Technology, and the Economy are Interdependent

The battle for the economic competitiveness of the United States and Texas in the early years of the 21st century is being engaged in classrooms today. Teachers are striving to lead this struggle, and technology will increasingly be the tool that enables them to succeed. Converging forces not only cause this struggle to be urgent but also provide both a challenge and an opportunity for educators to address nearly intractable educational problems. These trends include:

- the internationalization of the economy
- the shift in employment trends to a service-based economy
- the pervasiveness of technology and its impact on the efficacy of teaching and learning and efficient delivery
- the changing demographic makeup of the workforce and of the classroom
- the unacceptable costs of under-education.

Technology offers a primary means of increasing productivity while lowering costs. Technology not only reduces labor costs, it can also improve quality, improve the efficient use of resources such as energy and raw materials, and minimize risks to the health or safety of personnel. America's preeminence in the application of technology to mass production has been among the primary reasons for the relatively high standard of living for American citizens.

One of the goals of public education is to prepare America's youth for their future roles as productive participants in the economic system. As technology and the economy change, so must the schools change in order to prepare citizens for new economic realities.

## a. Internationalization and Competitiveness of the Economy Require an Educated Texas

The economy of the United States is becoming increasingly internationalized. This trend is illustrated by the fact that:

- The percentage of the Gross National Product entering international trade rose from 9 percent to 25 percent between 1950 and the end of the 1970s.
- 70 percent of all goods produced in the United States are in direct competition with foreign-produced goods (Marshall, p. 3).

Asian countries, in particular, have become increasingly prominent in this international competitiveness. In 1984, 37 percent of all imports into the United States came from Asia, which is the largest supplier of products to this country. More than 50 percent of the trade deficit derives from trade with Asian countries (U.S. Congress, Office of Technology Assessment, 1988a, p. 287). As a result of these and related factors, almost 3 million more jobs were lost in 1984 to imports than were gained because of exports (*Ibid.*, p. 291).

This economic competition and the resulting pressure to increase diversification in the state's economy have significant implications for education. One of the products of a quality education system, a skilled workforce, is both essential for attracting new business and crucial to the success of existing industry. According to the United States Secretary of Labor,

> We are rapidly approaching a new century and a vastly different labor market from the one we know. Major changes are already taking place. The number of new jobs is growing, and most experts agree that the skill levels of many of these jobs will be rising. Such skills will be vital to our domestic economic growth, as well as our ability to compete abroad (U.S. Department of Labor and U.S. Department of Education, p. ii).

Numerous surveys and interviews with executives have confirmed the importance of a sound education system in business location decisions, especially for high-technology and research and development firms. The major national annual business climate surveys and ranking systems strongly emphasize the availability and productivity of the labor force (Lyndon B. Johnson School of Public Affairs, pp. 177-178). In a 1986 survey of Texas companies, the availability of a highly educated labor force was one of the two location factors most frequently cited by business leaders (*Ibid.*, p. 234).

One of the reasons that business leaders select sites with a well-educated workforce is to reduce employee training costs. The future workplace will demand thorough grounding in basic academic proficiencies as well as the ability to adapt to new circumstances and learn new skills. The higher the skill level of an employee entering an organization, the lower the costs of providing that employee with both remedial and specialized training. Advanced employee skill levels are associated with reducing both start-up and operating costs.

## b. The Economic Sectors in Texas are Changing

In Texas, the results of this international competition and other pressures are felt most acutely in the oil field, agriculture, and labor-intensive manufacturing, as illustrated by the loss of employment in these key industries. For example, from 1982 to 1987,

- Employment in oil and gas production fell 40.2 percent, from 303,200 jobs to 181,400; employment in these areas, formerly as traditional to Texas as cowboys, dropped from 4.8 percent to 2.8 percent of all jobs in the state (Texas Employment Commission, n.d., pp. 1-2).

- Agricultural employment dropped 26.1 percent, from 253,000 to 187,000 jobs (U. S. Department of Labor, Bureau of Labor Statistics, 1982-1987).
- In manufacturing, employment fell 11.2 percent, from 1,045,200 jobs to 928,300 (Texas Employment Commission, n.d., pp. 1-2). While actual employment in Texas is projected to grow, the manufacturing share of total employment is projected to continue to decline from about 30 percent to 25 percent by 2000.

Although employment is decreasing in such traditional Texas industries as oil, agriculture, and manufacturing, there is evidence that employment in other sectors, specifically services, is increasing. Data for total United States employment indicate that goods-producing industries will show almost no aggregate employment change while service-sector employment will account for almost all of the projected growth through the Year 2000 (U.S. Department of Labor, Bureau of Labor Statistics, 1987, p. 3). Employment trends in Texas are projected nearly to parallel those of the nation. The service sector will experience a 27-percent growth rate during this period generating close to 70 percent of total job growth. As a result of this growth, the service sector will comprise one-third of all nonfarm salaried jobs by 2000 compared to about 22 percent in 1987 (Texas Employment Commission, 1988, p. 26).

Disaggregated by subsector, the service economy in Texas is projected to experience by 2000 a 52-percent increase in business services, 48-percent increase in health services, 44-percent increase in computer and data processing services, and 38-percent increase in need for teachers and instructors (Texas Employment Commission, pp. 29-37).

These employment shifts will have profound implications for education for many of the occupational groups experiencing faster-than-average growth will require the most educational preparation. These occupational groups include executive, administrative, and managerial workers, professional workers, and technicians and related support workers.

### c. Technology Pervades the Economy

The tools of daily life contain increasingly sophisticated technological components from microwave ovens to automobiles with computer-controlled ignitions to television programs bounced from satellites to offices replete with word processors and data management systems.

Emerging technologies will produce rapid changes in society, and, as a result, a premium will be placed on adaptable organizations, institutions, individuals, and policies (Marshall, p. 24; and Strategic Economic Policy Commission, p. 19). In order for Texas to pursue economic diversification by attracting new business and industry to the state, these adaptable organizations, individuals, and policies must be developed. The education system, among whose purposes is to prepare individuals to be productive citizens, must mirror and anticipate the world in which its students will be living.

Texas, however, risks forfeiting its future.

- Of the 15 most populous states, Texas ranked fifteenth in 1986 in per capita expenditures on technology programs.
- The state that ranked first in such expenditures (Pennsylvania) spent 65 times as much as Texas; even the state that ranked fifth (Georgia) spent 40 times as much as Texas (*State Technology Progress in the United States,* Minnesota Department of Energy and Economic Development, September 1986; cited in *ibid.*).

Because technology is crucial to the success and competitiveness of the state economy in a global marketplace, students must be prepared for the technical tasks that will be required of them in their careers. Technology must be integrated into education, both as a field of study and as a means of delivering instruction.

## 2. The Costs of Inaction are Intolerable

This effort to infuse education with technology not only will hold benefits for the economy and society in general; technology also holds significant promise for addressing several intractable problems facing public education, as well.

### a. Too Many Texas Students Fail to Graduate, Causing Personal and Economic Hardship

Among the most intransigent education problems in Texas is the number of students who fail to graduate from high school. An estimated 34 percent of all students who entered ninth grade in 1982 failed to graduate in 1986. The statistics for ethnic minority students are even more alarming: approximately 41 percent of Black students and 43 percent of Hispanic students who entered ninth grade in 1982 dropped out within the next four years.

The high dropout rate in Texas is not a recent phenomenon. Because of an historical pattern of failure to graduate, an estimated 3.5 million adults in Texas (36 percent of the adult population) have completed fewer than 12 years of school, and 1.8 million (18 percent) have completed fewer than nine years. As a result, Texas ranks third in the nation in rate of illiteracy (Texas Education Agency).

Although difficult to quantify, there is little debate that the cost of dropouts for society and for individuals—the human tragedy of broken dreams and of lost potential and creativity—is monumental. The additional severe economic consequences of dropping out, however, can be enumerated for the relationship between educational attainment and personal economic performance is well established. Individuals who have achieved higher levels of schooling not only benefit more than others during times of economic growth but also suffer less during downturns. This relationship was illustrated during the period from 1973 to 1984 when Real Mean Annual Earnings of 20- to 24-year old males declined by level of educational attainment as follows:

**DECLINE IN REAL MEAN ANNUAL EARNINGS BY LEVEL OF EDUCATION**

**20- to 24-Year Old Males 1973-1984**

| | |
|---|---|
| No diploma | -41.6% |
| High School Graduate | -30.1% |
| Some College | -26.1% |
| College Graduate | -11.0% |
| Total Cohort | -33.2% |

Source: Berlin and Sum, pp. 10-11

Estimates indicate that an individual who leaves school before graduating earns approximately $150,000 less over his or her lifetime than does a graduate (Texas Education Agency). A sustained increase of even one grade level in basic skills for a 19-year old would result in a 3.5-percent increase in lifetime earnings (Taggart, p. 24).

Among the many factors that place young people at risk of dropping out is educational achievement. The dropout rate for students age 14 to 15 who fall in the lowest quintile of basic skills is 20.6 percent compared to 2.8 percent for students in the highest quintile. A more dramatic picture is revealed when considering students who do not graduate despite having completed 10 years of schooling. In this instance, students in the lowest quintile of basic skills experience a 50.5 percent dropout rate compared to 3.8 percent for students in the highest quintile (Taggart, p. 18).

Students who learn become graduates who earn.

## b. Inadequate Education Produces Social Repercussions

In addition to the effect on individual economic performance, individual skill levels also are related to other conditions that have an economic impact on society in general. The costs of not preparing the state's citizens for productive and self-reliant lives are high.

All too often the conditions are carried across generations, resulting in a pernicious "cycle of poverty" in which children are the victims. Education can play a key role in breaking the cycle and in improving a child's chances for a purposeful life, but frequently the problems place the child at a severe disadvantage with respect to schooling.

> From the time they enter school [these high-risk children] are often observed to be underdeveloped in their social skills, emotionally troubled, linguistically and cognitively well behind their peers who come from more fortunate circumstances. By the third grade many of them are found to be unsuitable for the science education that could equip them for even moderately technical occupations later in life (Hamburg, D. "Early Intervention to Prevent Lifelong Damage: Lessons from Current Research," 1987, committee testimony, pp. 1-2; cited in Marshall, p. 70).

Teen pregnancy is a particularly serious problem in Texas. Texas leads the nation in pregnancy among girls 14 years old and younger and has the third-highest pregnancy rate in the nation for girls between the ages of 15 and 19 (Southern Governor's Association, pp. 6, 12, 36). Teen-aged mothers and fathers are very likely to drop out of school: eight of ten school-age mothers and four of ten school-age fathers leave school prior to graduation. Young, under-educated mothers are more likely to have infants who suffer from neglect or abuse and who may suffer from a variety of physical or mental handicaps. These children have special educational needs that can be very costly to meet. In fact, the cost of teenage childbearing in Texas in 1986-87 is estimated at over $400 million (Texas Department of Human Services).

The situation is not hopeless, however; evidence suggests that early intervention, particularly in the education of young mothers, can help break the intergenerational cycle of poverty. A 17-year longitudinal study of teenage mothers concluded,

> Contrary to expectations, teenage childbearing did not lead inexorably to a lifetime of poverty and dependence for all women. More than half eventually escaped poverty altogether. Education was the most potent avenue for escape from poverty and welfare, even when a mother waited until her twenties or thirties to go back to school. Mothers who returned to school were more likely to marry and more likely to work. This change in the mother's own life generally resulted in measurable improvements in the achievement of her children (Furstenberg, F., *Adolescent Mothers in Later Life*, 1987; cited in Marshall, pp. 71-72).

It has been estimated that the nonmonetary benefits of schooling are equal to two-thirds of the individual's wages (Haveman and Wolfe, "Education, Productivity, and Wellbeing," *Education and Economic Productivity*, 1984; cited in Marshall, p. 61). One additional year of school for a mother results in a reduction of 9 per 1000 in child or infant mortality. Education also leads to better health,

greater knowledge of health care services, and better general nutrition. Educated parents are more likely to have healthier and better-educated children, thus curtailing the cycle of at-risk youngsters bearing at-risk babies who enter school within five years as at-risk students.

## c. Demographic Developments May Exacerbate the Costs

The ethnic distribution of original entries into Texas public schools is projected to differ significantly from that in 1988. Ethnic minority populations in Texas are superseding the majority.

While projected to constitute the largest single ethnic group in the public schools into the 21st century, Anglo enrollment is growing at less than one-half the rate of Hispanic enrollment. The growth in Hispanic enrollment, in fact, accounts for nearly 50 percent of all projected growth in original entries between the 1987-88 and the 2000-01 school years. These projected data are displayed in the following table.

**PROJECTED PUBLIC SCHOOL ORIGINAL ENTRIES BY ETHNICITY**
**1987-1988 through 2000-2001**

| Academic Year: | 1987-88 | 1990-91 | 1995-96 | 2000-01 |
|---|---|---|---|---|
| ANGLO | | | | |
| Number | 1,706,603 | 1,749,563 | 1,853,847 | 1,964,347 |
| Percent Change | | 2.5% | 6.0% | 6.0% |
| Percent of Total | 51.8% | 51.1% | 49.9% | 48.8% |
| HISPANIC | | | | |
| Number | 1,037,799 | 1,102,643 | 1,236,836 | 1,388,729 |
| Percent Change | | 6.2% | 12.2% | 12.3% |
| Percent of Total | 31.5% | 32.2% | 33.3% | 34.5% |
| BLACK | | | | |
| Number | 484,306 | 484,896 | 493,945 | 503,163 |
| Percent Change | | 0.1% | 1.9% | 1.9% |
| Percent of Total | 14.7% | 14.2% | 13.3% | 12.5% |
| ASIAN AND OTHER | | | | |
| Number | 65,892 | 81,277 | 117,222 | 169,063 |
| Percent Change | | 23.3% | 44.2% | 44.2% |
| Percent of Total | 2.0% | 2.4% | 3.2% | 4.2% |
| TOTAL | | | | |
| Number | 3,294,601 | 3,424,357 | 3,712,690 | 4,025,300 |
| Percent Change | | 3.9% | 8.4% | 8.4% |

Note: Population totals for academic years 1987-88 and 1990-91 were obtained from the Pupil Projections Model as of May 31, 1987. Subsequent totals were derived by applying the annualized rate of increase (.0163) for the total pupil population represented in Texas Education Agency projections. Totals for individual ethnic groups were calculated by applying the "percent change" figures represented in projections from Marshall & Bouvier Table 6.4 to percentage shares found in the 1987 Fall Survey of Pupils in Membership State Report.

Source: Texas Education Agency

Historically, minority groups are statistically more likely to drop out of school than nonminority. This tendency is, of course, not a result of ethnicity but is, instead, closely related to poverty, a condition that is more concentrated among minority populations and households headed by single women. An

increasing level of resources must be dedicated to the assistance and remediation of these groups in order to forestall the development of an expanding cohort of individuals who are increasingly welfare dependent, who experience a disproportionate number of births to teenagers, and who manifest increased instances of social pathologies.

Technology alone cannot decrease the dropout rate or solve the social ills related to under-education; single solutions do not exist for complex problems. Nevertheless, as a component in a broad effort to address these issues, it can play a critical role—by improving the efficiency of the educational system, by increasing the productivity of teachers and administrators, by providing all students with high quality instruction, and by meeting the continuing education needs of adults in literacy, basic skills, job retraining, and career and personal development.

In the absence of this *Long-Range Plan for Technology*, undirected proliferation of educational technology could increase the polarization of educational opportunity in the state, allow inefficient allocation of scarce public resources, and impose grave economic burdens on public institutions. In the absence of a state plan, technology use in public education would expand in those districts wealthy enough to implement programs through local initiative. Those districts characterized by high-cost needs and insufficient local resources and awareness might continue to be isolated from the benefits of educational technology and, therefore, exhibit increasing disparity in student achievement and administrative efficiency. This potential expansion of polarization of educational opportunity would have severe economic consequences for the state.

## B. Legislation Mandates a Long-Range Plan for Technology

In addition to the social and economic imperatives, the State Board of Education is required by law to develop a long-range plan for uses of technology in education. Specifically, Chapter 14 of the Texas Education Code stipulates the establishment of a computer software advisory group, board approval of software, equal access by all districts to software approved or contracted for by the board, regardless of a district's economic situation, and the development of a long-range plan for:

(1) using technology-based systems for instructional purposes in the classroom;

(2) evaluating, developing, and acquiring computer software for use in the classroom; and

(3) fostering computer literacy among public school students.

Additional legislation, Texas Education Code Section 11.33(b)(1), requires the board to encourage, through a program of financial assistance for computer services offered by the regional education service centers, a planned statewide network or system of computer services to meet public school educational or information needs.

Finally, Vernon's Texas Civil Statutes Article 4413(32h), Section 2.08 requires a long-range plan outlining the needs of the Texas Education Agency regarding telecommunications devices and systems and automated information systems and the computers on which they are automated.

These requirements and the needs on which they are based are being addressed in a variety of ways. Particularly noteworthy is the Automated Information and Telecommunications Council (AITC), a state agency whose purposes are to (1) improve the cost effectiveness of state telecommunications

expenditures by updating biennially the state's 15-year telecommunications plan, (2) review and certify state agency and institutional plans and procurements for telecommunications, (3) ensure connectivity among and standards for individual agency and institutional telecommunications devices, (4) improve state government's use of telecommunications equipment and facilities by maintaining inventories, and (5) support professional development of state telecommunications personnel. In addition, the State Purchasing and General Services Commission establishes and implements procedures for purchasing equipment and materials, including technological and telecommunications systems for state agencies in Texas. Oversight and coordination are also provided by the State Auditors Office and the Comptroller of Public Accounts. Implementation of this long-range technology plan will be coordinated with the activities of the AITC and other state agencies.

A Software Advisory Committee has recommended a process for determining and distributing information about quality software. The Information Systems Advisory Committee advises the Commissioner on the development of the Public Education Information Management System which establishes an orderly sharing of management data among the local, regional, and state education agencies. The resulting *Information Systems Long-Range Plan* complements this plan for instructional and administrative uses of technology for classroom instruction, distance learning, and instructional management. Finally, the Research and Information Committee of the Commissioner's Advisory Council, composed of the executive directors of the regional education service centers, advises the agency on technology and plans delivery of computer services from the centers to districts.

These vital but disparate legislative mandates also are encompassed within the scope of this long-range plan for educational technology. This plan coalesces the already-targeted strands of software evaluation, a statewide network, and Texas Education Agency telecommunications needs with the other needs of the system in the four priority areas for educational technology use through the Year 2000.

## C. The *Long-Range Plan of the State Board of Education for Texas Public School Education, 1986-1990* Requires a Long-Range Plan for Technology

A third set of reasons compelling the adoption and funding of a long-range plan for educational use of technology concerns the *Long-Range Plan of the State Board of Education for Public School Education*, adopted by the board in 1987. Actions in the plan stipulate the use of technology; in addition, the mission and goals and many objectives of the plan can be productively met through the application of technology.

### 1. Technology is Needed to Comply with the *Long-Range Plan of the State Board of Education, 1986-1990*

The goals of the *Long-Range Plan of the State Board of Education for Texas Public School Education* and the accompanying actions that specify technology state:

**GOAL 1: Student Performance.**
All students will be expected to meet or exceed educational performance standards.

**GOAL 2: Curriculum.**
A well-balanced curriculum will be taught so that all students may realize their learning potential and prepare for productive lives.

*Action by the State:* "The state will investigate, provide assistance on, and encourage implementation of distance-learning technologies in order to provide a well-balanced curriculum to all students."

*Action by the Regional Education Service Centers:* "Mechanisms for delivery of services to smaller units through the use of alternative technologies should be implemented."

**GOAL 3: Teachers and Teaching.**
Qualified and effective teachers will be attracted and retained.

*Action by the State:* "The state will investigate, provide assistance on, and encourage implementation of distance-learning technologies to overcome the absence of qualified teachers in sparsely populated areas."

**GOAL 4: Organization and Management.**
The organization and management of all levels of the educational system will be productive, efficient, and accountable.

**GOAL 5: Finance.**
The financing of public education will be equitable to all students in the state.

**GOAL 6: Parent and Community Involvement.**
Parents and other members of the community will be partners in the improvement of schools.

**GOAL 7: Innovation.**
The instructional program will be continually improved by the development and use of more effective methods.

*Action by the State:* "The state will coordinate public and private telecommunications systems for delivery of distance instruction and administrative services."

*Action by the State:* "The state will implement a system and establish standards for evaluation and equitable distribution of software throughout the education system."

*Action by the Regional Education Service Centers:* "A coordinated statewide system of computer and other technology services must be provided to meet districts' educational and informational needs."

*Action by the Districts:* "Districts should adopt technologies that help manage the instructional program and that increase efficiency of teachers and administrators."

**GOAL 8: Communications.**
Communications among all public education interests will be consistent, timely, and effective.

Thus, the *Long-Range Plan of the State Board of Education for Public School Education* directs the state, regional, and local levels of the education system to use technology to solve myriad educational problems. This plan carries out that directive.

# 2. Technology is Needed to Achieve the Mission of Quality, Equity, and Accountability

> Texas is moving toward the 21st century amid a period of dramatic change in the economic conditions of both the state and the nation. The educational system of the state is responsible for preparing our children to live and work in this changing future...Educating our children to be productive in a changing future necessitates an excellent educational system. A system that can accomplish this mission must be characterized by quality, equity, and accountability.
>
> - Instruction must be provided at the highest levels of **quality.**
> - Educational opportunities and resources must be distributed with **equity** for all students.
> - The educational system must maintain **accountability** for demonstrated results and continuous improvement.
>
> Such a system will have the vitality to prepare our children for the changes and the challenges of the future, a future which will belong to the educated.
>
> *Long-Range Plan of the State Board of Education for Public School Education, 1986-1990*

This Mission of Education, adopted as the standard bearer of the board's *Long-Range Plan*, recognizes the changing economic landscape of Texas and the concomitant needs to revise the content and delivery of education in order to maintain a high-quality and efficient educational system and to ensure that Texas young people are prepared for the jobs of the future. Further, it establishes as the hallmarks of the system Quality, Equity, and Accountability.

This mission and these goals of the *Long-Range Plan* have guided educational improvements toward higher student achievement, higher standards for teachers, clearer standards for district performance, improved data collection, and other significant accomplishments. Nevertheless, considerable effort remains in order to attain the highest levels of quality, equity for all students, and accountability for demonstrated results. Quality, equity, and accountability must not be simply pledged; they must be synonymous with education in Texas. Technology can help make them so.

## a. Quality

Instruction at the highest levels of quality demands that:

- Every student should be able to meet or exceed minimum performance standards.
- Every student should be able to learn at his or her own pace and learning style.
- Every student should be able to receive instruction from the best teachers.
- Every teacher, administrator, and staff member should be able to participate in high-quality and consistent inservice instruction.

### 1) Student Performance Shows Both Significant Gains and Room for Improvement

Student performance is measured in several ways. The Texas Educational Assessment of Minimum Skills (TEAMS) measures basic reading, writing, and mathematics skills. The Scholastic Aptitude Test (SAT) indicates likely success in post-secondary education.

As illustrated in the following table, performance of the nearly one million students on TEAMS in February 1988 shows significant improvement in basic skills at the third-, fifth-, and seventh-grade levels over the previous two years.

**PERCENT OF ALL STUDENTS PASSING ALL TEAMS TESTS TAKEN**
**1986 through 1988**

| | 1986 | 1987 | 1988 |
|---|---|---|---|
| Grade 3 | 52% | 63% | 69% |
| Grade 3 (Spanish version) | — | 72% | 78% |
| Grade 5 | 57% | 60% | 72% |
| Grade 7 | 57% | 65% | 73% |
| Grade 9 | 55% | 58% | 58% |

Source: Texas Education Agency

While this improvement is noteworthy, the following table illustrates that a significant achievement gap exists between Black and Hispanic students and their white counterparts. Although it has decreased somewhat between 1986 and 1988, this achievement gap, coupled with the increasing membership of these minorities in school populations, might continue to have serious consequences for the public education system and the Texas economy.

**PERCENT OF ALL STUDENTS PASSING ALL TEAMS TESTS TAKEN**
**BY ETHNIC GROUP**
**1986 through 1988**

| | 1986 | 1987 | 1988 |
|---|---|---|---|
| GRADE 3 | | | |
| Black | 37% | 48% | 57% |
| Hispanic | 38% | 50% | 59% |
| White | 64% | 74% | 78% |
| GRADE 5 | | | |
| Black | 42% | 47% | 60% |
| Hispanic | 43% | 47% | 60% |
| White | 68% | 70% | 82% |
| GRADE 7 | | | |
| Black | 41% | 49% | 60% |
| Hispanic | 45% | 54% | 63% |
| White | 69% | 75% | 82% |
| GRADE 9 | | | |
| Black | 37% | 42% | 41% |
| Hispanic | 41% | 46% | 45% |
| White | 67% | 68% | 70% |

Source: Texas Education Agency

Further, the achievement gap between ethnic groups in passing rates on the TEAMS exit test has increased during this same period. The gap in the percentage of Black and white students and of Hispanic and white students passing the three tests was 25 points and 17 points, respectively, in 1985. The gap increased to 30 points and 22 points, respectively, in 1987.

Although Texas seniors, on the whole, have improved basic skills achievement, as tested by TEAMS, their performance on college entrance examinations, such as the Scholastic Aptitude Test (SAT), has trailed the national average (The College Entrance Examination Board, 1988, p. 1).

**U.S. AND TEXAS MEAN SAT SCORES**
**1984 and 1988**

| | U.S. 1983-84 | Texas 1983-84 | Difference | U.S. 1987-88 | Texas 1987-88 | Difference |
|---|---|---|---|---|---|---|
| TOTAL | | | | | | |
| Verbal | 426 | 413 | -13 | 430 | 417 | -13 |
| Mathematics | 471 | 453 | -18 | 476 | 462 | -16 |
| BLACK | | | | | | |
| Verbal | 342 | 335 | -7 | 353 | 346 | -7 |
| Mathematics | 373 | 364 | -9 | 384 | 381 | -3 |
| MEXICAN-AMERICAN | | | | | | |
| Verbal | 376 | 365 | -11 | 382 | 372 | -10 |
| Mathematics | 420 | 409 | -11 | 428 | 422 | -6 |
| WHITE | | | | | | |
| Verbal | 445 | 435 | -10 | 445 | 437 | -8 |
| Mathematics | 487 | 471 | -16 | 490 | 479 | -11 |

Source: Texas Education Agency and The College Entrance Examination Board

During the period from 1984 to 1988,

- The gap persisted between Texas SAT scores and those of the nation. (The percentage of Texas seniors taking the test, however, increased from 36 percent to 44 percent.)

Particularly troubling is the disparity in scores on college entrance examinations between minority and nonminority seniors, both in Texas and in comparison to national averages (The College Entrance Examination Board, 1988, p. 2).

**GAP BETWEEN WHITE AND OTHER ETHNIC GROUP SAT SCORES**
**1984 and 1988**

| | U.S. 1983-84 | Texas 1983-84 | Difference | U.S. 1987-88 | Texas 1987-88 | Difference |
|---|---|---|---|---|---|---|
| WHITE - BLACK GAP | | | | | | |
| Verbal | 103 | 100 | -3 | 92 | 91 | -1 |
| Mathematics | 114 | 107 | -7 | 106 | 98 | -8 |
| WHITE - MEXICAN-AMERICAN GAP | | | | | | |
| Verbal | 69 | 70 | +1 | 63 | 65 | +2 |
| Mathematics | 67 | 62 | -5 | 62 | 57 | -5 |

Note: The gap was calculated by subtracting Black and Mexican-American students' scores from white students' scores.

Source: Texas Education Agency and The College Entrance Examination Board

- The verbal and mathematics SAT scores of Black seniors in Texas increased from 335 to 346 and from 364 to 381, respectively, despite an increase of 68 percent in the number of Black seniors taking the test between 1984 and 1988 (The College Entrance Examination Board, n.d. and 1987b).
- But, scores of Texas Black seniors trail those of Black seniors nationally by 7 points on the verbal test and 3 points on the mathematics test (The College Entrance Examination Board, 1988, p. 2).
- Black seniors' scores in Texas fall behind those of white seniors by 91 and 98 points on the verbal and mathematics tests, respectively (*Ibid.*).
- Similarly, a gap exists in both the verbal and mathematics scores between Mexican-American seniors relative to the scores of whites in Texas and those in the nation (*Ibid.*). A 78-percent increase in the number of Mexican-American seniors in Texas taking the SAT between 1984 and 1988 is a positive sign (The College Entrance Examination Board, n.d. and 1987b).
- Nevertheless, scores of Mexican-American seniors in Texas fall 65 and 57 points on the verbal and mathematics tests, respectively, behind those of white students in Texas (The College Entrance Examination Board, 1988, p. 2).

Under any circumstances, gaps in performance by ethnicity are intolerable. As the number and percentage of minority students increase, concerted action must be taken to eliminate these disparities. Computer workstations and telecommunications systems can help overcome these gaps. They can provide diagnosis of learning styles, self-paced advancement from reinforcement and grounding in basic skills through challenging higher-order skills, presentation of and practice with the essential elements, and interaction with materials, skills, and concepts beyond the essential elements.

### 2) Effective Instruction Adapts to Individual Learning Rates and Styles

> Above all, the state must lead in conveying the expectation that all students can learn...
>
> *Long-Range Plan of the State Board of Education for Public School Education, 1986-1990*

The primary principle of educators is that all children can learn. This expectation alone can help improve student achievement. Students learn, however, in different ways and at different rates.

A major impetus for the use of technology involves transforming massed classroom instruction into an approach that accommodates individual differences within the general population and within populations having special educational needs, such as the mentally, physically, or culturally disadvantaged. For many students, adaptive instruction provided through technology may be the only alternative to failure.

A common educational paradigm involves a teacher guiding an entire classroom of students through the same material at the same time, regardless of students' distinctive learning styles. One study of the errors made by elementary school students, for instance, found 150 distinguishable patterns of errors in simple subtraction problems alone (U.S. Congress, Office of Technology Assessment, 1988a, p. 243). Typically, however, students receive less than one minute each day of individual attention from their teachers (*Ibid.*, p. 48). This paradigm requires the educator to "teach to the middle," splitting the difference between fast and slow learners. Studies indicate that, at any given time, an average of 20 percent of students experience difficulty understanding the teacher's comments or directions (Goodlad, J., *A Place Called School*; cited in *Ibid.*, p. 250), and teachers move to new material when only 30 to 50 percent of the students have mastered only 80 percent of the material (*Ibid.*, p. 250).

As a result, individual students rarely receive instruction that fits their capabilities. Fast learners may experience boredom, while slow learners may become frustrated, unable to keep pace with their peers. Neither boredom nor frustration should characterize schooling.

Technology can help overcome these negative affective and motivational side-effects. Students who receive computer-assisted instruction report that they enjoy moving at their own pace and suffer less embarrassment about mistakes than in conventional classroom instruction (National Governors Association, p. 15).

Computer-based technologies can help meet diverse learning styles and preferences in many ways: by giving the teacher greater flexibility in classroom arrangements, for example, whole-class, individual, or collaborative student groupings; through the use of computer diagnostics to identify and respond to patterns of student reasoning strengths and errors; by giving the teacher greater control of the ideal media for expressing certain ideas, such as the superiority of pictures over text for some types of problems; and, by making it possible for the student to assume greater responsibility for his or her own education, thus building self-esteem.

Computer workstations and telecommunications systems can help tailor education of the many to tutelage that is unique. Some students learn faster from text, others from lecture, repetition, visualization or simulation, and others from analogies drawn from areas of personal interest. Through diagnosis and adaptive courseware, workstations can individualize learning. Through distance delivery of instruction, isolated students can receive specialized courses.

### 3) Masterful Teachers are in Short Supply

Teacher supply and demand are projected to remain in balance until approximately 1991-92 when the labor market is expected to tighten. In addition to this tightening in the aggregate, figures reveal that teacher shortages in specific curriculum areas already exist. A survey of a sample of districts in Texas shows that at least:

- 89 percent of sampled districts report at least some shortage of bilingual education teachers.
- 71 percent show a shortage of special education teachers.
- 50 percent show some to extreme teacher shortages in mathematics, science, and pre-kindergarten (Aki, p. 4).

These shortages are most likely a result of mismatched location of supply and demand.

These shortages are likely to be exacerbated in the 1990s. The number of initial teacher certificates issued by the state has dropped every year since 1982-83 for an overall reduction in certificates of 41 percent between that year and 1986-87. In addition, between 1984-85 and 1985-86, the number of provisional certificates issued by Texas institutions in such high-need areas has plummeted.

**DECLINE IN PROVISIONAL CERTIFICATES IN SELECTED AREAS**
**1984-85 and 1985-86**

| | |
|---|---|
| Bilingual Education | -52% |
| Physically Handicapped Education | -41% |
| Composite Science | -34% |
| Kindergarten | -28% |
| Mathematics | -12% |

Source: Texas Education Agency

Through emergency permits and other means, only four percent of vacancies remain unfilled. Thus, disturbing as these figures are, the numbers of teachers needed to fill classrooms mask the greater issue—that of quality. The Texas teaching profession is characterized and, through implementation of reforms, will continue to be characterized by highly qualified teachers. They do not, however, reside in every classroom in the state. As revealed by earned degrees, Texas teachers have attained a lower level of education than teachers nationally; over one-half of the teachers in the United States have received a master's degree, while only one-third of Texas teachers have earned this degree. Furthermore, students in districts that are small, of below average wealth, or that have a high percentage of Black, Hispanic, or low-income students are less likely to be instructed by teachers with a master's degree and more likely to receive instruction from teachers with a bachelor's or no degree than are other students (Texas Education Agency).

Subject-area and pedagogical experts brighten classrooms across Texas and throughout the United States. Through distance delivery of instruction, their expertise can be magnified and shared in all parts of the state.

Computer workstations and telecommunications systems can help overcome shortages and address concerns regarding quality. They can supplement on-site teaching staff's capabilities with masterful instruction. Workstations with interactive, diagnostic courseware can provide the information of expert teachers, pacing instruction and freeing teachers to coordinate group activities and guide student question-asking. Distance instruction through directed satellite delivery, public broadcasting, and many other means can deliver experts and master teachers directly to classrooms where both teachers and students benefit from model presentations and interaction.

Through classroom and distance technologies, the traditional hierarchical relationships between teachers and students can be modified. Teachers—in a configuration different from the standard one teacher per classroom—can facilitate the learning by small or large groups of students who control their own pace.

### 4) Educators Need Continuing Education

Like all professionals, teachers, administrators, and other professional education staff need inservice training in advances in subject-area knowledge, in pedagogy, in effective management techniques, and in other areas related to their specialties. In fact, law and rule require teachers and administrators to participate in extensive continuing inservice education.

Each of the more than 180,000 teachers in Texas is required to participate in a minimum of four days of inservice each year and, in order to advance on the Teacher Career Ladder, to participate in additional college work and/or in up to 135 hours of Advanced Academic Training (AAT). In addition, up to 12,000 administrators must receive thorough and uniform training in teacher appraisal during 1989; each of the nearly 15,000 administrators in Texas is required to participate in General Management Training in 1989-90; and, based on appraisal results, each of the 15,000 must also participate in continuing training annually thereafter.

Another area in which the need for consistent inservice is great is in preparing teachers and administrators to meet the state mandate for gifted and talented programs. More than one-half of the districts that provided operational programs in 1986-87 must add programs at six grade levels by 1990-91. In addition, 625 districts offered no gifted and talented programs in 1986-87 and must do so at all grade levels by 1990-91 (Texas Education Agency).

Furthermore, the commissioner of education has the authority to designate additional priority topics in which all administrators need consistent skill development. Other staff, such as counselors and librarians, also need continuing education.

Above all, all professionals will require substantial training in integrating technology effectively into instruction and management—training that is often most appropriately conducted by technology. Despite this need, however, only approximately one-third of teachers in the nation have received up to 10 hours of computer training, and less than one-third of preservice teachers feel ready to use computers (U.S. Congress, Office of Technology Assessment, 1988b, pp. 98-100).

As in the nation as a whole, delivery of inservice in Texas is neither sufficient to meet the high need nor uniformly available. This gap is illustrated by the relative paucity of inservice that has been provided in the area of gifted and talented education. Staff in 61 percent of developmental programs for gifted and talented students in Texas reported offering 30 hours or less of teacher training, and 83 percent reported offering 30 hours or less of training for administrators. Furthermore, only 37 percent of districts with operational programs provide one or more days of training on working with gifted underachievers, an important segment of the population to identify and serve (Texas Education Agency).

Telecommunications systems can be a significant component in delivering the extensive ongoing training in which Texas educators are, by legislation and by professional expectations, required to participate. Delivery by distance or other electronic means from a minimum number of trainers can ensure uniform training across the state in such critical areas as teacher and administrator appraisal, areas in which consistent training at every site is imperative. Easily available electronic delivery can also replace the one-time-only training session that characterizes the current train-the-trainer model with frequent interaction, continuing follow-up, and ongoing staff support. In addition, electronic delivery of inservice can target the training needed by teachers and administrators in sparsely populated districts that are struggling to meet legislative and regulatory mandates.

Through helping students attain or exceed minimum performance expectations and national norms on basic and advanced skills tests, through matching individual learning styles and rates, through leveraging master teachers, and through delivering inservice instruction, technology can help raise the quality of education in Texas.

## b. Equity

Equity for all students demands that:

- Every student should be able to receive instruction in every required course and in any additional appropriate course; course work available in the state to one student should be available to all students.

- Every student should have access to the data and primary resources that will help him or her formulate questions and seek solutions; information available to one student in the state should be available to all students.

Equity—defined as equal access to the curriculum that will help Texas students prepare for work and higher learning and as equal access to information for self-directed inquiry—remains a goal in Texas.

### 1) Access to Instruction is Inequitable

State Board of Education rules for curriculum require districts to provide a minimum number of specified courses at least every other year so that students can take the required curriculum. Data on course enrollments indicate that some districts may be unable to meet these requirements.

Of 983 districts showing membership in the ninth, tenth, eleventh, or twelfth grades in 1985-86 and 1986-87,

- 656 districts (66 percent) did not show enrollment in at least one of the English courses which districts are required to offer. Of these districts, 548 did not show enrollment in either Composition or British Literature.
- 237 districts (24 percent) did not show enrollment in at least one of the mathematics courses which districts are required to offer.
- 214 (22 percent) did not show enrollment in at least one of the science courses which districts are required to offer.
- 42 districts (4 percent) did not show enrollment in any foreign language course; an additional 124 districts did not show enrollment in the two levels of the same foreign language which districts are required to offer.*

These disparities in curriculum delivery have serious consequences for individual student achievement and for the state. When Texas young people must struggle to receive minimum course work, they are too often ill-prepared for work, and they are unequipped to enter or succeed in higher education.

As indicated in the following table on mean SAT scores, course offerings, measured in the number of academic hours attempted by seniors, show a positive correlation with performance on test scores: the higher the number of academic units, the higher the SAT score. In fact, Texas seniors with 17 or more academic units slightly outscore seniors in the nation as a whole when comparing those with the same number of academic units.

**U. S. AND TEXAS MEAN SAT SCORES BY NUMBER OF EXAMINEES' ACADEMIC COURSE UNITS 1987-88**

| | Verbal | | Mathematics | |
|---|---|---|---|---|
| Number of Academic Units | U.S. | Texas | U.S. | Texas |
| 20 or more units | 478 | 479 | 530 | 531 |
| 19 or 19 1/2 units | 448 | 454 | 498 | 503 |
| 18 or 18 1/2 units | 430 | 437 | 479 | 487 |
| 17 or 17 1/2 units | 412 | 413 | 457 | 459 |
| 16 or 16 1/2 units | 394 | 394 | 436 | 435 |
| 15 or 15 1/2 units | 381 | 377 | 421 | 416 |
| Fewer than 15 units | 359 | 354 | 399 | 392 |

Source: Texas Education Agency and The College Entrance Examination Board

Students who do not have access to such courses are prevented from excelling.

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* These data were derived from the Superintendent's Annual Report, Part II, 1985-86 and 1986-87, which indicates the number of students enrolled in every course. Lack of enrollments does not necessarily signify that districts are not offering a course, however, since, in any given two years, students may not be available or eligible to take the required courses.

Furthermore, a positive association exists between the number of honors and advanced courses completed by gifted and talented students and higher scores on the Preliminary Scholastic Aptitude Test (PSAT) (Texas Education Agency). Such programs, however, are not uniformly available. Of 625 districts that did not offer state-approved gifted and talented programs in 1986-87, 41 percent reply that they would offer such services to students if they were available by distance (Texas Education Agency). As a result, the goal of increasing course offerings throughout the state is not simply desirable in the pursuit of equity; it is also a means by which excellence can be achieved.

In addition to these honors and required courses, most districts offer additional courses in order to meet the diverse learning needs and interests of their students. Data indicate, however, disparities in the array of courses offered across the state. Significant differences exist among districts in the average number of courses offered.

**AVERAGE NUMBER OF COURSES OFFERED**
**BY DISTRICT SIZE**
**1985-86 and 1986-87**

| District Size (Average Daily Attendance) | Number of Districts | Average Number of Courses Offered |
|---|---|---|
| 50,000- Over | 6 | 208.83 |
| 25,000-49,999 | 14 | 173.57 |
| 10,000-24,999 | 43 | 147.74 |
| 5,000- 9,999 | 41 | 117.63 |
| 3,000- 4,999 | 91 | 105.01 |
| 1,600- 2,999 | 114 | 83.89 |
| 1,000- 1,599 | 124 | 76.10 |
| 500- 999 | 205 | 69.26 |
| Under- 500 | 399 | 53.78 |

Source: Texas Education Agency

The average number of courses offered also varies considerably by type of district.

**AVERAGE NUMBER OF COURSES OFFERED**
**BY DISTRICT TYPE**
**1985-86 and 1986-87**

| District Type | Number of Districts | Average Number of Courses Offered |
|---|---|---|
| Major Urban | 8 | 200.38 |
| Major Suburban | 61 | 134.20 |
| Other Central City | 23 | 148.13 |
| Independent Town | 67 | 101.52 |
| Other Central City Suburban | 72 | 96.88 |
| Non-Metropolitan Fast Growing | 154 | 71.88 |
| Non-Metropolitan Stable | 210 | 78.35 |
| Rural | 442 | 55.60 |

Source: Texas Education Agency

Particularly disturbing is the disparity of courses offered according to the percentage of low-income students living in districts.

**AVERAGE NUMBER OF COURSES OFFERED BY PERCENTAGE OF LOW-INCOME STUDENTS 1985-86 and 1986-87**

| Percentage of Low-Income Students | Number of Districts | Average Number of Courses Offered |
|---|---|---|
| Under 20% | 235 | 84.50 |
| 20% to under 30% | 207 | 75.97 |
| 30% to under 40% | 217 | 76.63 |
| 40% to under 60% | 229 | 71.44 |
| 60% to under 80% | 107 | 70.70 |
| 80% and over | 42 | 69.95 |

Source: Texas Education Agency

Fully 93 percent of the districts in the state, representing 44 percent of total Average Daily Attendance (ADA), offer less than the median Average Number of Courses Offered of 131.31.

While some of the inequity in access to courses may be explained by the lack of student interest in a subject—or by lack of students—some portion is explained by the inability of some districts to offer some courses. Reasons for a district's not offering a course can include the inability to obtain qualified teachers for a given curriculum area, the inability to pay the salary necessary to attract those teachers, inadequate facilities, or an insufficient demand by students to justify expenditures to overcome these delivery barriers. Resolving the causality is unnecessary, however: students must be able to choose from a full menu of courses, thereby stimulating interest and providing skills and knowledge that might not otherwise exist.

By breaking down the barriers of distance, providing economies of scale necessary for cost-efficient delivery of instruction, and leveraging the talents of excellent teachers, technology can be a powerful tool for expanding the menu of courses available to students in the state's education system. In doing so, both equity and excellence can be achieved.

### 2) Access to Information and to Information Technologies is Inequitable

> ...the desire of information, like the thirst of riches, increases ever with the acquisition of it.
> *Laurence Sterne*

Information and the knowledge and wisdom that derive from it are the substance and the goal of education. Increasingly, information is the substance of the economy as well. From 1900 until the middle of the 20th century, most American workers were employed in industrial jobs. Since that time, however, an increasing number of American workers have become information workers.

By any measure, the United States is now an Information Society.

- At least 54 percent of the American workforce is composed of information workers.
- 63 percent of all equivalent working days in the United States are devoted to information work.

- Even noninformation workers spend one-quarter of their time in information activities, while virtually none of information workers' time is spent handling goods or materials.

- Information work accounts for 67 percent of all labor costs in the United States because information workers receive wages and benefits that are 35 percent higher than those of noninformation workers.

- 70 percent of all work hours in the United States are devoted to information work, because information workers put in an average of 10 to 20 percent more hours per week than do those engaged in other occupations (Strassmann, *Information Payoff: The Transformation of Work in the Electronic Age.* 1985, p. 56; cited in Rogers, p. 12).

Thus, to deny citizens in an information economy access to information is to deny them their livelihoods. To deny it to young people is to deny them their futures. Information today constitutes riches, and they increase together. Inequity in information distribution, therefore, is tantamount to sentencing a portion of the population to ignorance and poverty.

Traditionally, information for students has been contained within textbooks, teacher presentations, and libraries. Today, through the proliferation of computer data bases and television, information is widely available from many sources. At the same time, as an increasingly important sector of the economy, it is also a commodity whose acquisition must be planned for and whose security, when necessary, must be guaranteed.

It is incumbent on educators to open to students the many doors to information. Through these doors, students can learn to ask their own questions to which they can seek the answers, to formulate their own problem statements to which they can seek resolutions, to sift fact from fiction, and to organize the facts into meaning. These are the skills of a lifetime.

There is evidence, however, that today's doorways to information, computers, electronic telecommunications systems, and other technologies, like the curriculum, are not universally available in Texas.

- With an average of one computer for every 30.5 students, Texas ranked only 24th among the 50 states in 1987-88 in computer availability, a drop from 22nd in 1986-87. In regard to videocassette recorder (VCR) placement, the state ranked 30th, with one VCR for every 287.1 students.

In addition, distribution and use of these technologies vary widely across the state.

- The density of computer availability ranges from one computer for every six students in some districts to one for every 95 students in others (Hayes, pp. 168 and 192-196).

- Of 213 districts that did not use computer services for administration in 1985, 80 percent were small, 74 percent were rural, and 60 percent were of below average wealth (Texas Education Agency).

Technology can help open the doorways to information—but only if the equipment is available.

### c. Accountability

In addition to their core teaching duties, teachers are expected to diagnose learning styles and rates, measure acquisition of essential elements and track student achievement, maintain discipline

records, and respond to a plethora of administrative details. Administrators also report burdensome paperwork requirements because of the necessity to record and report financial and accounting information, student and personnel data, measurement results, and adherence to regulatory and legislative mandates.

Substantial research (reviewed in Education Commission of the States, p. 7) documents the extent to which paperwork constitutes a high percentage of a teacher's noninstructional time. It represents a serious problem because administrative and paperwork duties detract from activities more important to a teacher's primary mission—meeting with students.

Despite paperwork reduction efforts, a 1987 survey of Texas teachers identified paperwork as a primary source of teacher frustration and as the single most preventable cause of teacher burnout. The same survey found that approximately 72 percent of Texas teachers reported spending over seven after-school hours per week on paperwork (Lutz and Maddirala, pp. 3-22).

A 1988 report by the Carnegie Foundation for the Advancement of Teaching asked teachers across the nation whether they believed that the burden of bureaucratic paperwork had increased, decreased, or remained the same over the past five years (Carnegie Foundation for the Advancement of Teaching, p. 59). Nationwide, 52 percent of all teachers reported increased paperwork burdens; 40 percent indicated no change; and 8 percent reported a decreased burden. In Texas the numbers were somewhat different: 61 percent of Texas teachers responded that the burden had increased; 29 percent indicated no change; and 10 percent believed that paperwork burdens had decreased.

Research on the allocations of teacher time spent in various duties normally uses teacher self-reports, but in some instances the allocations have been quantified by time analysis studies. A preliminary report of such a study in North Carolina in 1987 found that teachers in the state spend an astonishing 51.9 percent of their time in activities other than teaching (Public School Forum of North Carolina, p. 28). One classroom teacher said:

> The time study has perhaps been as revealing to some teachers as for those outside the teaching profession. We knew we were spending long hours outside the classroom on jobs related to teaching, but the tallied figures have been shocking to those of us who have never attempted to keep any kind of record of those hours (*Ibid.*, p. 29).

The North Carolina study team also collaborated with a hardware developer to conduct a technology needs survey; the group concluded that many of the problems of schools, in terms of work overload, conflicting time and role demands, excessive bureaucracy, and outmoded information and communication systems, could be eased using up-to-date technologies (*Ibid.*, pp. 42-47).

Despite their importance for ensuring maintenance of records for accountability and student achievement, these tasks need not be burdensome. Through automation and rapid data transfer, technology-based management and expert systems can alleviate the tedium and time often associated with such reporting requirements. Relieving teachers of such labor-intensive record keeping allows them to concentrate on teaching; integrating technology into education will not necessarily save teachers time, but it will allow them to devote their working time to teaching. Relieving administrators of the need to monitor the collection and transmission of such data allows them to support the educational functions of schools.

Among the foremost methods of achieving these results at the state level is the Public Education Information Management System (PEIMS). This system combines the bulk of school district data collection to streamline reporting, reduce duplication, and produce a standard set of statewide data on staff, finances, organization, students, dropouts, and facilities. The statewide data that are

collected and aggregated are used not only at the state level. They will also be returned in computer-readable files and on paper to the districts for local comparisons with similar districts and for decisionmaking and accountability and will be shared with researchers at institutions of higher education and research organizations. Thus, the system will broaden the access to information about and analysis of education in Texas. In the long term, local data reporting efforts will be reduced while accountability will increase. Computerization will hasten and increase the efficiency of the PEIMS effort.

Computerization will also support the Agency's effort to automate the fund flow system. This system, which will also use PEIMS data for expenditure reporting, will standardize procedures for applications and expenditure reports, establish a common fiscal reporting period, and expand technical assistance through, for example, guiding budget development and funds management at the district level on a computerized program.

These state-level efforts have important corollaries at the local level. Data can be consistent and transferable among all levels of the education system. In addition, the technologies used to support PEIMS and automated fund flow can be available for campus and district administration and management, including recordkeeping, communications, and information exchange.

Failure to implement this *Long-Range Plan for Technology* at all levels could allow the development of programs and systems that are not compatible and of products (instruction and data) that cannot be easily transferred, that do not provide the benefits of economies of scale in software and hardware purchases, and that may not further the objectives and goals of the state as a whole. Technology can help ensure accountability in Texas education.

## D. A Vision of Education on the Frontier of the 21st Century

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

*T. S. Eliot*

Education by the turn of the century can be what education has always strived to be, what education always should have been. Education by the turn of the century can prepare young people for productive work lives and for lives committed to continued learning. Education by the turn of the century can contribute to a state-of-the-art Texas. Technology can contribute to a leading-edge education system.

Technology can help achieve in Texas an education system in which:

- No student would be denied, by virtue of district sparseness or teacher shortage, course work necessary for employment or higher education; and, no student would leave school early because of a mismatch between learning and teaching styles.

- Teachers can have both the responsibility and the technical resources to guide the instruction of their students in the most appropriate and efficient ways.

- Performance, not processes, can determine advancement.

- Performance and socioeconomic status are unrelated.
- Adults can continually enhance their job and life skills.
- Insatiable curiosity can be nourished.

Technology-infused education can help achieve in Texas a climate in which:

- Texas can be a beacon for business and industry.
- Employment can rise.
- The secure jobs of the future can belong to Texas.
- Quality of life can improve for all citizens.

The education system that can produce these results will be very different from the education system of today. Technology is a dynamic catalyst that converts as it infuses. The education system that can produce these results will be replete with:

- students who are exhilarated by learning, who complete their high school education and advance as they are ready into work, higher education, or military service
- teachers who are ardent about teaching, gratified by their students' measurable progress and unburdened by mechanical tasks
- administrators who are zealous about the achievements and efficiencies of the systems they manage.

The education system that can produce these results can flourish in Texas. This *Long-Range Plan for Technology* can help produce these results. Technology integrated into the priority areas of classroom instruction, distance learning, instructional management, and communications can help meet the needs of education in Texas, can help achieve the mission of quality, equity, and accountability, can help establish the vision of education at the turn of the century—at the turn of the millenium.

# II. TECHNOLOGY CAN HELP MEET THE NEEDS AND ACHIEVE THE VISION

## A. Technology Works

Considerable research and evaluation have been conducted on the effectiveness of computers in instruction and learning. While some of the hopes and speculations regarding the utility of technology in meeting educational needs have not yet been realized, technology far less powerful than that currently available has already amassed a proven record of significantly improving the quality and efficiency of education. Furthermore, as newly emerging and blueprint technologies, described below, supersede those on which research has been conducted, the positive effects are likely ever to increase.

### 1. Basic Skills Can be Acquired More Thoroughly and More Quickly With the Aid of Technology

The use of technology, along with many other solutions, shows promise of improving students' basic skills, reducing the amount of time needed to learn these skills, and improving students' attitudes toward school.

Several meta-analyses (analyses of the results from a collection of studies) indicate that computer-assisted instruction (CAI) generally produces small but significant increases in achievement test scores. The improvement rate varies according to the grade range studied and the application, but, at a minimum, achievement increases from the 50th to the 60th percentile on such tests (Bangert-Drowns, et al, p. 65). Other meta-analyses find improvements from the 50th to the 61st percentile (Kulik and Kulik, p. 224), to the 63rd percentile (Samson, et al, p. 313), and to the 68th percentile (Kulik, et al, p. 59).

Furthermore, according to some analyses,

> Computer-based teaching had its clearest effects in studies of disadvantaged and low aptitude students...This analysis provides the strongest evidence yet available that the computer has an especially positive contribution to make in the education of disadvantaged high school students (Bangert-Drowns, et al, p. 66).

This finding is substantiated by a meta-analysis of past meta-analyses that states, "Six reviews at various grade levels found that slow learners and under-achievers seemed to make greater gains with computer-based methods than more able students (Roblyer, et al, p. 30)." The authors caution that "Many of the studies which yielded high effects with slow learners were of systems *designed for* this population (Roblyer, et al, p. 30)." More recent analyses, however, have "found no evidence of differences between students on the basis of ability levels (Roblyer, et al, p. 54)."

Other relevant results indicate that "Students learned their lessons with less instructional time," the average reduction being 32 percent, and that students liked both their classes and computers more when computers were used in instruction (Kulik and Kulik, p. 224). A general conclusion of these meta-analyses states that

> CAI (1) has real potential as a tool in improving student involvement in precollege classes; (2) fosters positive attitudes toward the computer; and (3) can produce substantial savings in instructional time...A safe conclusion is that the computer can be used to help learners become better readers, calculators, writers, and problem solvers (Kulik, p. 1).

Studies of programs in Texas corroborate these results. For instance, the Judson Independent School District used a reading and instructional management system for reading remediation among 35 students. Nineteen of these students, slightly over one-half, scored at or above the 50th percentile and no longer needed remediation.

In addition, commercial learning centers have shown success in increasing literacy and in assisting potential and actual dropouts to acquire certificates of high school equivalency through a computer-based program. The Comprehensive Competencies Program, for instance, provides individualized instruction pursued on a self-paced basis with attainment measured and tracked on computer. The program also provides the ability to diagnose learning pathologies and prescribe remedies. Data indicate that learners have gained an average of 1.1 grades in reading in 31 hours of reading instruction and of 1.6 grades in mathematics in 28 hours of mathematics instruction (Taggart, p. 28). Participants in Adult Basic Literacy Education (ABLE) have increased reading and mathematics skills by an average of one grade level for every 40-50 hours of computer-based instruction combined with tutoring (Mendel, p. 30). Another technology-based program that offers hope to adolescents and adults hampered by a low reading level is Principles of the Alphabet Literacy System (PALS) which uses interactive videodisc. During one 10-week summer session, the reading level of ninth- and tenth-grade students in Florida who were identified as low readers and who met eligibility requirements established by the Job Training Partnership Act rose an average of three grade levels (McGraw, p. 21).

As a result of these successes, a report on workforce literacy produced by the Sunbelt Institute recommends that "Computer-assisted instruction, interactive video disks, television, and other modern technologies must be incorporated more fully into literacy and adult education programs (Mendel, p. 33)." Similarly, a report by the Adult Literacy and Technology Project concludes, "It is imperative...to find ways to make technology, and through the technology, literacy instruction, accessible to everyone (Turner, p. 3)."

## 2. Higher-Order Skills Can Be Improved With the Aid of Technology

The higher-order skills that will be needed to support the economy of the state and the livelihood and welfare of the state's citizens can be significantly and demonstrably enhanced with the aid of technology. For instance, the average achievement level of junior high school general mathematics students on a standardized test of problem solving rose from the 33rd to the 68th percentile over four years of television instruction (Chu and Schramm, p. 2). The Higher Order Thinking Skills (HOTS) Program developed by Dr. Stanley Pogrow of the University of Arizona shows gains in thinking skills and social interaction that continue beyond the experimental experience. In the HOTS program, commercially available software is used to develop in at-risk students the thinking skills of metacognition, inference, decontectualization, and synthesis. As conceived by Pogrow, the HOTS program "is an alternative to Chapter I programs in grades three through six that replaces all compensatory content instruction and drill and practice with thinking skills activities (Pogrow, p. 11)."

Results of the program, as reported by Pogrow, indicate that, "in addition to gains in thinking skills and social interaction, schools are generating gains exceeding 15 percentile points (reaching as high as 25 percentile points) on standardized tests the first year. Gains continue in the second year. Standardized math scores are also up substantially without specific math activities the first year. Indeed, HOTS students have been outperforming students in computerized drill and practice programs (Pogrow, p. 11)."

Pogrow emphasizes that it is not the computer alone that is responsible for these successes. The technology is a tool that must be used with the HOTS curriculum, teaching techniques employed by trained teachers, and instruction in the regular curriculum. He explains that "the key to using computers to enhance learning in transferable ways is not the computers or programs themselves but the dialogue that ensues between teacher and students (Pogrow, p. 13)."

## 3. Technology Can Help Meet the Needs of Special Education Students

Special needs students, those with physical and mental handicaps, can in many cases be reached more effectively through technology than with only teacher-student contact. "Adaptive/assistive devices" can compensate for sensory communication, mobility, and manipulation deficits. Technological examples of such devices include braille writers and printers, speech synthesizers, reading machines, and eye movement detectors. Project ACTT (Activating Children Through Technology), for instance, integrates microcomputers with speech and music synthesizers, graphics tablets, and other devices, into educational programs for mildly to severely handicapped children to the age of eight years. Preliminary results indicate that computer use increases attention span, retention, social interaction, and aspects of problem solving (Hutinger, p. 5).

A preliminary research project at the University of California at Los Angeles indicates that using speech synthesizers with adolescents with Down's syndrome increases the teenagers' speaking, reading, and writing abilities. Within 10 sessions, more than 80 percent of the students gained at least six months in mental age on at least one-half of the standard tests (Kolata, p. 15).

Videodisc technology for instruction and management developed at Utah State University has been shown to be effective in teaching some content, such as telling time, and skills, such as social interaction skills, with children with mild intellectual handicaps (Hofmeister and Friedman, pp. 360-361).

Technologies can be effectively used to assist management and diagnosis of special needs students as well as to support their instruction. Several programs exist, for instance, that periodically list children due for Individualized Education Program (IEP) review and automatically report necessary data to state and other agencies (Bennett, p. 107). Preliminary evaluations of expert systems to diagnose handicapped students as learning disabled indicate that the expert system's conclusions "were comparable to those of the 'better' human experts and more acceptable than those of the majority of human experts (Parry and Hofmeister, p. 131)." Similar studies of the use of expert systems to diagnose reading problems "revealed that the expert system provided more detailed information than human diagnostic reports (*Ibid.*, p. 130)."

# 4. Distance Learning is a Proven Means for Providing Effective Instruction and Inservice

Distance learning refers to instruction and inservice that are delivered over a distance via telecommunications or other means or on-site via technology and is comprised of at least one of the following characteristics: (1) the instruction supplements or comprises entire course content; and/or (2) the instruction is available from an instructor in real time; and/or (3) the instruction is interactive with the instructor and/or with courseware and data available on student workstations.

Telecommunications- and computer-based technologies offer the ability to deliver instruction to districts where it is currently unavailable in order to meet the needs of equity and quality cited above. Such instruction by distance can be provided—and, to some extent, already is offered—through a variety of means. Most notably, public broadcasting offers supplemental instruction to over 800,000 students on 918 campuses in approximately 200 districts in Texas. The 11 Texas Public Broadcasting Association (TPBA) stations, of which nine provide instructional television (ITV) programming, cover 97 percent of the state geographically (Texas Public Broadcasting Association). The wide array of programming delivered by public broadcasting stations enriches and broadens students' knowledge and experiences and informs teachers as well. An estimated 35 districts in Texas also deliver supplemental instruction, teacher inservice, and other school services over local cable or broadcast networks.

In addition to the supplemental instruction that is provided by public broadcasting, course work for credit is also offered through videotape, telecommunications- and computer-based technologies, and through combinations of these. Five distance learning efforts in the state, four based at regional education service centers and one at the University of Texas at Austin, have been approved to offer a total of 50 courses for credit since 1986. There are approximately 2500 enrollments in distance courses for credit in the fall semester of the 1988-89 school year. Providers of distance learning courses for credit in Texas include:

- TI-IN Network, Inc. which delivers courses nationwide, including to 136 districts in Texas, by a four-channel satellite system. (TI-IN offers additional instructional services to students and teachers in 88 districts.)

- Regional Instructional Television Consortium which uses both instructional television fixed service (ITFS) and 12 cable systems in the Dallas-Fort Worth area to deliver TI-IN teacher inservice, student courses, and supplemental instructional material to 65 districts

- InterAct which provides teacher inservice and courses of study to approximately 947 students in 19 districts in Region IV via ITFS with four channels

- Region IX Service Center in Wichita Falls which offers Spanish video tape and audio talk-back to 13 area school districts

- Education Instruction Materials Center at the University of Texas at Austin which provides Health Occupation Education to seven districts by telephone (Texas Education Agency).

The following table displays by subject area the number of districts that offer courses for credit by distance in the fall semester of the 1988-89 school year.

**NUMBER OF DISTRICTS OFFERING APPROVED COURSES FOR CREDIT BY ALL DISTANCE LEARNING METHODS BY SUBJECT AREA FALL SEMESTER, 1988-89**

| Subject Area | Number of Districts |
|---|---|
| Art | 19 |
| Computer Science | 14 |
| English | 6 |
| English as a Second Language | 48 |
| Foreign Languages | 298 |
| Health | 1 |
| Health Occupations | 7 |
| Mathematics | 75 |
| Psychology | 62 |
| Science | 44 |
| Sociology | 31 |

Source: Texas Education Agency

During the 1988-89 school year, three additional distance learning efforts have been implemented. In the first effort, an additional distance learning provider is offering courses in Texas. In the second and third efforts, federal funding for two projects through the "Star Schools Program" increases the number of courses offered and sites capable of receiving programming.

- Oklahoma State University offers Physics and Calculus to schools in Texas.

- The Satellite Educational Resources Consortium (SERC), which is composed of representatives from public television stations and state departments of education, including Texas, offers two courses—Japanese and Probability and Statistics—as a pilot package to four schools in Texas during the second semester of the 1988-89 school year. For pilot purposes, twelve students will participate from each state in each course. Further expansion of the system is planned for subsequent years.

- The TI-IN United Star Network is a consortium of state departments of education, colleges and universities, Education Service Center Region XX, and TI-IN. Star Schools funding through this consortium provides 50 additional TI-IN receive sites as well as additional courses and inservice for subscribers to TI-IN. Further expansion of the system is planned for subsequent years.

Finally, 34 districts in Texas provide Physical Science for credit to approximately 6300 students via interactive videodisc. Beginning in the summer of 1989, this program plans to expand to reach additional students by being delivered over TI-IN.

Many additional efforts in other states and at the national and regional levels provide access to education-related information electronically. These include:

- the Software Communication Service, a 13-state consortium that offers to schools and colleges an extensive array of services, such as software and video preview, product procurement assistance and delivery, inservice training, and on-site technical support

- Learning Link, an 11-member national information system that features databases, information resources, inservice teacher training, message centers and electronic mail, and gateways to remote education databases

- the Curriculum Connection, a database about media-related instructional materials (such as educational television programs)

- EDucational Information Systems On-Line (EDISON), a computer-based management system that facilitates interaction among participating public broadcast stations, wire services, and other services such as those described above.

Texas must continue to investigate and seize the opportunity to participate in effective and efficient programs conducted in other states and at the national level.

Studies of distance deliverers of instruction generally indicate that students enrolled in distance-learning programs exhibit achievement and motivation at least as high as those shown by students in traditional settings. A survey of research on instructional television states, "The effectiveness of television has now been demonstrated...at every level from preschool through adult education, and with a great variety of subject matter and method (Chu and Schramm, p. 1)." The review cites positive results from individual studies, including the following:

- Fifth-grade children in a rural school gained 1.9 years in knowledge of arithmetical concepts on the Iowa Test of Basic Skills, measured against national norms, in 1.0 years of televised instruction.

- Tenth-grade students in urban schools rose from the 34th percentile before television instruction to the 51st afterward (*Ibid.*, p. 2).

The survey concludes, in part:

> Instructional television does make it possible to share teaching more widely...It does make it possible to give teachers more time to prepare, and make more resources for teaching. If new ventures are to be undertaken in education, if courses or materials not now available in existing classrooms can be offered there by television, or if television can be used to extend the benefits of education to children or adults not presently served by existing schools—then it would appear that television can be used for such purposes with considerable confidence (*Ibid.*, p. 6).

In regard to delivery by distance of courses for credit, a pilot evaluation project conducted by the Texas Education Agency of these distance learning efforts in 1985-86 corroborated the positive results associated with ITV. The study evaluated delayed videotaped Spanish courses (which were noninteractive in 1985-86), courses in German I and Psychology provided by ITFS, and Computer Science I, French I, and Psychology provided by satellite; the latter two systems were live one-way video and two-way audio. The evaluation concluded that:

- Overall mastery demonstrated by program students was equal to or better than mastery by comparable students in the traditional classes.

- Test scores suggest that these highly cost-effective services provide a good alternative source of instruction in cases where on-site teachers cannot be provided.

- Students feel that telecourses require more effort than traditional courses.

- Both telecourse and traditional teachers tended to rate their own courses positively.

- Most parents were favorable in their general opinions of televised courses (Texas Education Agency).

Opinions of students and parents were positively related to the level of interactivity represented in the particular telecourse medium, with videotaped courses at the least interactive end of the scale and satellite and microwave at the most interactive end of the scale (Texas Education Agency). This finding supports the importance of the teacher-student relationship suggested in other studies.

Another example of successful uses of technology to deliver curriculum to remote districts is the Technology Demonstration Site (TDS) program created by the Minnesota Education Technology Act of 1983. A wide variety of technologies is used in TDS schools, including in-class computers and two-way television for distance learning and inservice.

Findings of the Technology Demonstration Sites indicate that the instructional effect of these technologies is positive. To quote the Final Evaluation Report of the Technology Demonstration Site program,

> Technology has a high degree of perceived value and impact: virtually all of the large number of educators interviewed, surveyed or otherwise tested during this evaluation believe that technology, particularly computers, provides significant learning advantages. The data suggest that some applications of technology, namely interactive television, do provide advantages and do not measurably affect either classroom "climate" or academic achievement (Morehouse, Hoaglund, and Schmidt, 1987a, p. 5).

Advantages of interactive television listed by teachers include "enlarging programs and course options for students, providing challenge and growth opportunities for teachers, providing motivation and opportunities to build self-discipline among students, and the smaller class sizes which seem to be typical (usually 18 students or fewer) (Morehouse, Hoaglund, and Schmidt, 1987b, p. 4)."

## 5. A Statewide Telecommunications Network Can Improve Communications and Information Exchange at Reduced Cost

Approximately 650 districts, regional education service centers, and the Texas Education Agency communicate with each other and with professional associations and search educational data bases through electronic mail and bulletin board systems established under contract with a private vendor. In the spring of 1987, the agency and the contractor evaluated the system at 15 pilot districts (48 sites) that had used the network during the previous 17 months. Results of this joint evaluation indicate that a statewide telecommunications network can support statewide information exchange for administrative purposes as well as supplement instruction. A one-year model school program at two large districts also demonstrated the effectiveness of such electronic communications between a district office and its campuses.

Users of the system cited as benefits timeliness, improved communications, the ability to receive printed answers to questions quickly (not simply oral responses), and cost effectiveness (National Information Systems, Inc., p. 21). Cost analysis revealed that reducing mail, reproduction, printing, and long-distance telephone usage in favor of electronic communications could result in an overall cost savings of over $2 million per year, exclusive of personnel.

**COMPARISON OF ANNUAL COMMUNICATIONS OPERATING COSTS TRADITIONAL AND ELECTRONIC COMMUNICATIONS**

| | 1986-87 Cost | Projected Cost | Difference |
|---|---|---|---|
| TEA Communications | $1,195,300 | $871,370 | -$ 323,930 |
| TEA Electronic Communications | 12,000 | 15,000 | + 3,000 |
| District Communications | 3,405,000 | 340,500 | - 3,064,500 |
| District Electronic Communications | 120,000 | 817,200 | + 697,200 |
| Total | $4,732,300 | $2,044,070 | -$2,688,230 |

Source: Texas Education Agency and National Information Systems, p. 29

Recommendations included (1) reimbursing school districts to defray the costs of accessing information, (2) developing a uniform application format that would allow districts to access agency information, and (3) training administrators, teachers, and students in the use of an electronic communications system (*Ibid.*, pp. 33-36).

# B. Emerging Technologies and Educational Practice Will Evolve Concomitantly

## 1. Technology is Evolving

Technologies in use in schools today seem miraculous compared to those of just a decade ago. Those in use in the late 1990s will make those of the 1980s seem quaint.

Technologies in use in schools include:

- instructional television for supplemental instruction and inservice
- computers for drill and practice, tutorials, simulations, programming, and problem-solving exercises
- electronic communications systems for educating geographically isolated students using one-way video signals, sometimes enhanced by two-way audio signals
- communications networks for information and data exchange among education institutions
- information utilities, which connect workstations to various information sources, such as radio, television, newspapers, journals, books, and magazines
- teletext and videotext, which scan and retrieve information.

A broad current trend involves the synthesis of computers with telecommunications. The convergence and increased compatibility of many technologies is a current reality. In the future, the quality and capabilities of the technologies will increase, while costs are likely to decrease. Distance will no longer constrain the search for needed information. In practical terms, the new devices put the world of knowledge at the user's fingertips.

Emerging technologies offer enormous and unprecedented possibilities. Recent computer-related innovations greatly facilitate the entry, storage, and retrieval of very large amounts of information in multiple formats, including text, graphics, audio, and moving images. In the future, knowledge bases will be not only larger, but will be cross-referenced and linked to one another through public and other telecommunications highways, allowing users to browse through vast libraries of audio and video information.

Computer-based multimedia sometimes is referred to as "hypermedia." The technologies, in addition to the computer, that make hypermedia possible are:

- CD-ROM, an optical storage device of immense capacity
- the computer-controlled interactive videodisc player.

Although the components above are the ones most likely to influence the delivery of education in the near future, other areas of research suggest additional long-term possibilities. These include:

- voice recognition and synthesis, which facilitate communication between the computer and the user
- digitizing of print, audio, and video analog information, such as texts and videotapes
- superconducting materials, which may greatly enhance the speed, memory, and efficiency of computers
- vector and parallel processing, which use microprocessors to work simultaneously on different parts of a single large problem
- expert systems and artificial intelligence, which emulate human higher-order reasoning abilities
- neural networks, which allow machine learning and diagnosis of patterns and problems.

As these technologies are developed and marketed, applications for education must be encouraged. Schools in 2000 must not be relying on the technologies of 1988; they must have access to and reason to use the technologies of 2000. Business, education, and government must work together to transform the technologies developed for the workplace and the military into those appropriate for the classroom. Such cooperative effort in regard to military schools software is anticipated from the newly created Office of Technology Transfer within the U. S. Department of Education and other federal efforts. A product development consortium of business and education can move exciting training and applications technologies from the former to the latter. Furthermore, educators and taxpayers must be prepared to phase in new technologies and phase out or upgrade obsolete technologies on a cycle of approximately five years.

## 2. Education Will Evolve as Technology is Implemented

The attributes that make the new technologies attractive for instruction and management also imply great social and organizational change in the education system. In the long run, the technologies promise to alter what is taught (curriculum), how it is taught (pedagogy), where it is taught (in schools, alternative educational settings, workplaces, homes, or elsewhere), when it is taught (during

school hours, after school hours, weekends, or summers), and may induce debate on the whys of education (in terms of life skills, economic competitiveness, and personal enrichment). The extent of these changes has been described as a second frontier.

> Computing in education has a second frontier because an irreversible phenomenon of historic significance has been initiated that will deeply affect the potentialities and constraints of education. We can explore what lies beyond this frontier; we cannot return to a world in which the frontier does not exist (McClintock, p. 349).

For technology to make a genuine contribution in education, it must be allowed to shape and be shaped by the school and classroom settings. Its effect will be minimal if it is simply "added on" to the existing curriculum. The relationship between education and technology must be organic. Hardware alone cannot educate students. It remains for teachers, empowered by the technologies, to translate information into knowledge and wisdom on the part of the student; for students, similarly empowered, to formulate questions and to learn how to learn; and for administrators, also empowered by rapid data and information aggregation, to lead their institutions to ones characterized by diversity, efficiency, and achievement.

The two most common errors in technology planning assessment, however, are to overestimate the speed of diffusion of an innovation and to underestimate its eventual consequences (Dede, et al, p. 88). Integrating the new computing and communications technologies into education will require concerted effort. They will also provide teachers, students, and administrators with an array of rich alternatives to traditional teaching, learning, and managing.

Furthermore, while the emphasis of this plan is on the use of technology in school settings, technology will continue to have an impact on learning in the home and other settings. Television reaches over 90 percent of the homes in this country, and children and their parents have access to three major networks and public television. Nearly 50 percent of the homes in the country subscribe to cable television, providing an additional 20 to 150 channels for viewing. With this widespread coverage, it is possible to imagine a wide variety of information on parenting, careers, and other topics and courses offered both to adults and to students. This information could be broadcast as it is today; it could become interactive; it could be provided in the form of computer software and programs; and it could originate from a variety of sources.

### a. Teaching Will Evolve

The technologies will bring the media laboratory and the library into each classroom. For the teacher, this combination will enable the authoring and presentation of lessons using materials drawn from multiple audiovisual sources. Currently, a single audiovisual presentation may require multiple, bulky pieces of equipment—film projector, slide projector, audio tape recorder, videocassette player, overhead projector, and screen. In contrast, a teacher workstation that integrates the new technologies will make multimedia available to all teachers at all times. The same is true of library resources, such as books and journals. Entire libraries of text, pictures, and even full-motion videos with sound will fit onto only a few optical disks.

The teacher's computer will be a super-workstation, capable not only of superior presentations to the class as a whole but also of monitoring student progress during individualized or small-group sessions, thereby giving the teacher great flexibility in terms of instructional approach and classroom arrangement. The teacher's station will act as a file server that controls student access to a vast amount of software. The station also will assist the teacher with a myriad of administrative tasks, including attendance, lesson plan preparation, testing, grading, and report writing, thus freeing the teacher for planning and working with individual students.

In a student-centered classroom, the teacher's role will be to enable students to assume greater responsibility for their own educations. Teachers are more likely to facilitate learning, less likely to control it.

### b. Learning Will Evolve

For the student, the technologies mean a variety of educational experiences ranging from directed, interactive lessons to nondirected individual or cooperative exploration of diverse subjects. Directed lessons will use artificial intelligence or neural networks to diagnose and match the individual's unique learning style, providing feedback at appropriate intervals. Students will progress at their own pace, with some receiving intensive remedial assistance and others beginning advanced studies regardless of grade level. In general, students will learn more, faster.

In the long run, the new technologies could change assumptions about education. Under current practice, until test time neither the teacher nor the students can be confident that students have acquired the knowledge or skills. With the new technologies, however, students and teachers can receive immediate feedback on a lesson's effectiveness. As a student works through an individualized lesson, he or she leaves an electronic "trail" that can be traced and analyzed for information on how the student learns. The technologies may be the key that unlocks the mystery of how students learn. Greater knowledge of student learning patterns, both individual and collective, promises to revolutionize the science of learning and the practice of teaching.

### c. Curricula Will Evolve

Changes in pedagogy and measurement, in the rates and methods by which students learn, and in the demands that will be placed on the citizenry and workforce of the future suggest changes in curriculum as well. Some leaders urge a utilitarian curriculum that includes familiarity with computers for data searches, word processing, and other applications (National Task Force on Educational Technology, p. 9). Others propose a "new literacy" that includes rhetoric to comply with voice recognition technologies (Compaine, pp. 156-59) or information analysis and evaluation, prediction and long-range planning, and aesthetics (White, p. 7). The federal Office of Technology Assessment projects new job skills to include problem recognition and definition, handling of evidence, analytical skills, implementation skills, human relations, and learning skills (U.S. Department of Labor, Office of Technology Assessment, 1988a p. 243). Former Secretary of Labor Marshall foresees a shift to higher-level skills, greater attention to language and international studies, and less concentration on textbooks (Marshall, p. 54).

Regardless of the specific skills and knowledge which adults will need in the 21st century, the citizenry must be flexible as the world continues to change. Provisions for content and procedures in the curriculum must be similarly flexible. Fortunately, State Board of Education Rules for Curriculum, Chapter 75, contain the processes for managing an evolving curriculum as Texans resolve these debates so that the state's children will be productive citizens.

### d. Management and Structure Will Evolve

For the administrator and other staff, technologies offer communications within schools and districts, between schools and parents, and among education and other public agencies across the state. The needs of students and families can be more productively met. Records of mobile students can travel with them rather than behind them. Students at risk need not be lost. Educational leadership can be thorough and consistent as local and state policymakers share information and guidance.

Concomitant developments might include alterations in the roles and relationships between instructional and administrative staff who will share technology hardware and highways to conduct their tasks. Governance of schools is likely to evolve as schooling itself evolves.

### e. Facilities Will Evolve

As electronic networks become wired and structural relationships within schools evolve, so will the buildings themselves. The architecture that conveys the transmissions and houses the new teaching, learning, and managing must be planned for long-term flexibility and change.

## C. Education will be Characterized by a Variety of Uses and Levels of Implementation of Technology in 2000, but All Districts Are Expected to Exhibit Minimum Attributes of Technology Use

The needs which technological tools address vary among districts and campuses in the state. This diversity will not diminish in the coming years. On the contrary, local flexibility—with accountability—and individualization will increase. In addition, some districts will be quicker to adopt emerging technologies than others. Thus, the extent to which technology will be implemented in the various districts will continue to vary.

Nevertheless, regardless of local variety and currently unanticipated hardware and functions, minimum common expectations are held for technology use that will apply to all districts and campuses. These minimum attributes are displayed in the following chart by functional type.

# Minimum Attributes

## 1. Student Workstations

| Objectives | Requirements |
|---|---|
| | In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate: |
| Students can receive and interact with instruction and information. | • computing ability<br>• input devices<br>• audio, video, color, and graphics capability<br>• expandability beyond the requirements of applications software<br>• upgradability |
| Individual and group mastery of essential elements can be continually monitored and remediated. | • tracking of mastery of essential elements<br>• access to teacher workstation modules |
| Students' and teachers' stations can interact for teacher-directed and peer learning. | • electronic mail<br>• local-area network (LAN) |
| Students can search and retrieve bibliographic and other information. | • access to selected databases |
| Districts can control access to student and teacher records. | • security of and access to external information |
| Students can interact with much of the information and develop some skills that are linked to and exceed the essential elements. | • delivery of interactive courseware keyed to and exceeding the essential elements |
| Students can prepare and print reports, graphics, etc. | • word processing and graphics production<br>• printer/output devices |





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# 2. Teacher Workstation Modules

| Objectives | Requirements |
| --- | --- |
| | In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate: |
| Teachers can conduct large group instruction, demonstrating simulations, preparing graphics and sound-enhanced lectures, and illustrating trends and concepts. | • large screen<br>• optical media, such as CD-ROM and video disc<br>• audio output<br>• instructional television<br>• recording and playback |
| Teachers can prepare and print reports, graphics, etc. | • word processing and graphics production<br>• expandability beyond the requirements of applications software |
| Teachers can use stations to conduct routine instructional and administrative "paper" work. | • recording of attendance, program placement, disciplinary actions |
| Teachers can send pre-instruction and post-instruction tests to students electronically. | • storage of and access to validated pre- and post-test item bank |
| Teachers can use station to grade tests, display results for student and teacher, aggregate results, and send report to appropriate location. | • local-area network (LAN)<br>• recording and aggregating of test results by specified factors (e.g., classroom and program)<br>• transmission of results to campus and district offices |
| Teachers can monitor individual and group mastery of essential elements and progress through the curriculum and adjust instruction accordingly. | • tracking of learning, including the essential elements and the curriculum |

| Objectives | Requirements |
| --- | --- |
| Teachers can analyze learning styles, diagnose learning problems, and adjust instruction accordingly. | • diagnostic and prescriptive software |
| Teachers can notify staff and parents of students' at-risk status. | • "early warning" indicators of at-risk students |
| Teachers can search banks of pre-designed or teacher-made lesson plans for instructional suggestions. | • storage of and access to commercially available and teacher-generated lesson plans |
| Teachers can download existing software written for dedicated machines. | • universal standard for various operating systems<br>• video, color, and graphics capability<br>• telecommunications reception |
| Teachers can send messages and assignments, etc., to students, staff, and parents. | • electronic mail<br>• routing of audio, data, and video signals through the same channel<br>• interactivity |
| Teachers can prepare lessons, check student achievement, and obtain information at home as well as at school. | • portable central processing unit (CPU), modem, and display screen for battery or plug-in use<br>• retrieval of bibliographic and instructional information from databases |
| Teachers can send attendance, grade, and other reports to district and regional offices. | • wide-area network (WAN) |
| Teachers can send paper reports to students, parents, and administrative offices and can create materials. | • printer/output devices |
| Teachers can receive training on use of workstation modules. | • training software |

# 3. Administrator Workstations

| Objectives | Requirements |
| --- | --- |
| | In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate: |
| Administrators' time to manage instruction can increase. | • local-area network (LAN)<br>• aggregation of data on test results and student achievement, attendance, financial statements, inventories |
| Administrators can retrieve and review data on achievement, course and bus schedules, inventories, budget, and other instructional and administrative factors. | |
| Administrators can write and send memoranda, etc., and record contacts with students and parents. | • word processing<br>• electronic mail<br>• printer/output devices |
| Administrators can access electronic, optical, and other data-bases. | • CD-ROM and other mass data retrieval systems |
| Administrators can send information to and receive information from TEA, other districts, regional education service centers, and buildings in the district. | • wide-area network (WAN)<br>• electronic mail |
| Administrators can record teacher assessment processes and results. | • software for teacher assessment |

# 4. Open-access Learning Centers

Note: Open-access Learning Centers, possibly located in campus libraries, will contain more sophisticated workstations and other technologies than those available to students, teachers, and administrators and will access a wider variety of databases. They will be available for training of and use by parents and other community members as well as students, teachers, and staff.

**Objectives**

Students, teachers, staff, and community members can receive training in technology use and application.

Students, teachers, staff, and community members can investigate subjects in depth.

Students can obtain nearly total course content and evaluation in subjects for which courseware is prepared, using public broadcasting and interactive video and audio computer-based stations.

Students, teachers, staff, and community members can produce high quality materials.

Parents and other community members can receive and interact with literacy training, job-related training, and technology training and course work in a wide variety of fields.

Open-access Learning Centers provide entertainment as well as didactic and research materials.

**Requirements**

In order to meet the educational objectives, the centers need to incorporate the following capabilities, standards for which will be established as appropriate:

- training software
- access to bibliographic and other information from a variety of databases
- instructional television
- video, color, and graphics capabilities
- interactive videodisc capability
- knowledge-based courseware
- audio capability
- evaluation capability
- compatibility with student and teacher stations
- printer/output devices
- electronic mail
- local-area networks
- input devices
- computing ability
- expandability beyond the requirements of application software
- upgradability
- diverse courseware and instructional materials

# 5. Telecommunications Centers

Note: The Telecommunications Center will be the locus for distance learning. "Distance learning" refers in general to instruction and inservice that are delivered over a distance via telecommunications or other means or on-site via technology and is comprised of at least one of the following characteristics: (1) the instruction supplements or comprises entire course content; and/or (2) the instruction is available from an instructor in real time; and/or (3) the instruction is interactive with the instructor and/or with courseware and data available on student workstations.

Telecommunications Centers will be configured differently depending on local need and decisions. In some cases, the Centers will consist of self-contained facilities dedicated to distance learning; in others, they will be portable units; in others, various functions will occur in different locations, including Open-access Learning Centers. For instance, all relevant classrooms should have the capability to receive instructional television.

| Objectives | Requirements |
|---|---|
| | In order to meet the educational objectives, the centers need to incorporate the following capabilities, standards for which will be established as appropriate. Other standards and processes will also be set: |
| Students can receive the course work they need regardless of location or teacher availability. | • mechanism for state approval of course content, materials, and delivery, and of teacher certification |
| Teachers can receive on-site inservice in technology training and other areas. | • audio interactivity<br>• data transmission capability<br>• video capability |
| Teachers and administrators can confer from school-based sites. | |
| Classroom instruction can be enriched with master teacher presentations, video presentations, and interactive data communications. | • video and audio capability through receipt of distance instruction<br>• instructional television |
| Communications among students and teachers at multiple sites can be interactive and live. | |

The State Board of Education Equipment Targets, established in the Action Plan that follows, phases in these technology configurations at the following rates:

| | Phase 1<br>1988-92 | Phase 2<br>1992-96 | Phase 3*<br>1996-2000 |
|---|---|---|---|
| Student Workstations | | | |
| Access Time | 1.3 hours/week | 5 hours/week | 7.5 hours/week |
| Ratios | 23:1 | 6:1 | 4:1 |
| Teacher Workstations | | | |
| Access Time | 2 hours/week | 15 hours/week | 30 hours/week |
| Ratios | 20:1 | 2.6:1 | 1.3:1 |
| Portable Workstations | | | |
| Access Time | 1.3 hours/week | 10 hours/week | |
| Ratios | 30:1 | 4:1 | |
| Administrator Workstations | | | |
| Access Time | 2.7 hours/week | 15 hours/week | 30 hours/week |
| Ratios | 15:1 | 2.6:1 | 1.3:1 |
| Districts with: | | | |
| Wide-area Network (TEA-NET) | 100% | | |
| Local-area Network | 100% | | |
| Open-access Learning Centers | 20% | 80% | 90% |
| Telecommunications Centers | 75% | 80% | 100% |

* Ratios in Phase 3 will depend on the results of research on optimal ratios.

# III. ACTION PLAN AND EXPECTED OUTCOMES

## A. Implementation of the Plan Requires Sufficient Hardware, Challenging Courseware, Staff Training, Delivery Systems, and Research and Development

### 1. Hardware Procurement and Purchase

Fundamental to the *Long-Range Plan for Technology* is the technology itself. Neither legislative mandates nor the State Board of Education's *Long-Range Plan for Public School Education*, neither economic needs nor the vision of education in the Year 2000 will be met if students and educators lack access to the technologies.

In order to ensure their acquisition,

- Funds must be provided so that districts are not placed in the predicament of needing to meet board goals without receiving support to do so.
- Districts must be able to select and purchase at the most reasonable cost compatible equipment that meets state and local standards and local needs.

### 2. Courseware Adoption and Provision

As technology infuses schools, electronic instructional materials will increasingly supplement and, possibly, supplant text materials. Such courseware (as distinguished from limited-purpose software), which, like textbooks, conveys substantial course content, warrants the attention of the textbook adoption process and committee.

In order to encourage the development of instructionally sound electronic media materials, modifications must be considered in the procedures and rules regarding textbook proclamations and adoption, and curriculum frameworks must include information about technology-related materials. In order to encourage distribution of software, electronic delivery should be investigated.

Above all, as the use of technology in instruction alters the educational landscape, curriculum rules, such as the essential elements and minimum class time for promotion and graduation, must be reviewed and revised.

## 3. Training and Certification

School closets are cluttered with materials which teachers have not been taught to use effectively. Technology works—but only if teachers are comfortable with it and integrate it into their lesson planning and if administrators encourage teachers and staff to use technology.

Inservice instruction is needed in appropriate uses of technology—not simply the mechanics of the machinery but the thoughtful integration of technology-based instructional materials into teaching and learning. As stated by the federal Office of Technology Assessment, "training in the use of technology will need to be a part of the preparation every entry-level teacher receives (U.S. Congress, Office of Technology Assessment, 1988b, p. 115)." This instruction, as well as inservice in a wide variety of areas, should take place using the relevant equipment, including distance delivery systems.

In addition, certification standards for distance teachers, some of whom deliver instruction from other states and countries and some of whose skills may differ from those of classroom teachers, must be considered.

## 4. Delivery Systems

A system of statewide telecommunications networks for information sharing among all entities in the public education system is imperative. Two types of systems are proposed during Phase 1 to meet instructional, inservice, and information needs. Ultimately, these systems are likely to merge into a combined network that performs a variety of functions.

The proposed electronic information transfer system can, using the Texas Education Agency's TEA-NET communications service, be used for inservice, technical assistance, electronic mail and bulletin boards, and supplemental instruction. The agency can share regulatory and other changes that need immediate attention; districts can transfer applications to the agency in a uniform and timely manner; teachers can share instructional ideas; regional education service centers can quickly respond to calls for assistance. The carrier for this service will be selected after careful delineation of state criteria, including standards for quality, service, cost, speed, ease of use, and security, evaluation of the extent of state ownership of the system, review of proposals from a variety of bidders, and consultation with telecommunications experts.

In addition, distance learning opportunities must be expanded by building on the rich variety of providers available in Texas and across the country. Through collaboration with other states and federal efforts, multiple deliverers, including public broadcasting, directed broadcasting, and on-site technologies, can be employed to meet the individual and group needs of students, teachers, administrators, and other staff for course work, supplemental instruction, and inservice.

Decisions regarding selection of these systems must continue to be made in cooperation with other state agencies and institutions of higher education in Texas in order to ensure efficiency and to prevent unnecessary duplication.

## 5. Research and Development

Advancements in the sophistication and power of technologies are certain; applications of technology to education are not. Business and industry needs for computers and related technologies proliferate, thereby expanding the market for machines and applications for these purposes. Equipment and software for educational purposes differ, and their development must be encouraged. Innovative ideas have required up to 20 years to move from basic research to

applications in schools (U.S. Congress, Office of Technology Assessment, 1988b, p. 151). The educational process already risks obsolescence. Students and teachers must not be forced to wait until 2008 to have access to the technologies of 1988.

In addition, as the *Long-Range Plan for Technology* is implemented and revised, future decisions must be based on research. Such important questions as the appropriate ratio of users to machines in various subjects and the best ways to use technologies to help non-English-speaking and other special students remain to be answered.

To address these issues, at least two key sets of actions must be undertaken. First, a consortium of businesses and industries engaged in technology development, textbook and software publishers, public broadcasting networks, and testing corporations should convene with public school educators, institutions of higher education, and others to conduct research on the effects of technology on teaching and learning and to develop prototype products. The proposed Center for Educational Technology, based at one or more universities, will be a beacon for both attracting high-technology businesses and researchers and for creating leading-edge products, priorities and standards for which will be established by the state.

Secondly, demonstration programs will test in school settings hardware, software and courseware, and changes in traditional educational processes suggested by the integration of technology. These investigations, with a variety of age groups, settings, technologies, content areas, and students (such as at-risk, physically handicapped, and others), will result in both improved practice and improved technologies for education.

Pervading all of these areas is the issue of quality. In every case—hardware, software and courseware and programming development, training, and delivery services—quality is paramount. The potential for technology in education, the vision of education, will not be reached unless every facet is characterized by high quality. Through research, state standards-setting, and communicating results among decisionmakers and users, quality must be assured.

The Action Plan that follows addresses each of these five areas. The calendar for these actions consists of three phases, each of four years, for the period 1988 to 2000. All entities—the state, regional education service centers, school districts and campuses, institutions of higher education, and the Center for Educational Technology—are expected to undertake the stated actions in order to implement this *Long-Range Plan for Technology* and to reach the stipulated outcomes.

Note: Each action and outcome is coded by Phase, Action Area, Responsible Entity and rank order. Each phase is designated 1, 2, or 3, as appropriate. The appropriate Action Area for Phases 1 and 2 is designated "H" (Hardware Procurement and Purchase), "C" (Courseware Adoption and Provision), "T" (Training and Certification), "D" (Delivery Systems), or "R" (Research and Development). For Phase 3, "Te" represents Technology Delivery and Content. Responsible Entities are designated in the code as "S" (State), "E" (Education Service Centers), "D" (District), "I" (Institution of Higher Education), or "C" (Center for Educational Technology). Finally, each Action within these categories is numbered sequentially, and each Outcome is lettered in alphabetic order. Thus, the first Action is coded "1HS1," representing Phase 1, Hardware Procurement and Purchase, State, Action 1. The first Outcome of this Action is labeled "a," the second "b," etc. Similarly, the second District Action regarding Courseware Adoption and Provision in Phase 2 is coded "2CD2."

# B. IMPLEMENTATION CALENDAR AND OUTCOMES

## PHASE 1: 1988-1989 through 1991-1992

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase | State | 1HS1. Establish a Technology Equipment Allotment that provides $50/ADA/Year, equalized, to districts for hardware and courseware purchases and facilities modification to be expended on an as-needed basis. | a. Computer-based technologies will be distributed equitably throughout the state so that technology acquisition will not vary according to district wealth.<br>b. Districts will be able to plan for and acquire technologies and technology-related goods and services, including alterations in facilities necessitated by integration of technology, on a long-range and cyclical basis.<br>c. All districts will offer the required curriculum. |
| | | 1HS2. Establish a statewide electronic information transfer system (TEA-NET) by providing to each district a computer, modem, telecommunications software, limited on-line time, and training and by arranging for a delivery vehicle through a process of establishing criteria, consulting with experts, evaluating the extent of state ownership of the system, and receiving proposals from a variety of bidders. | a. A statewide electronic information transfer system will be established so that all districts, education service centers, and the Texas Education Agency will improve communications and reduce paperwork by electronically sharing instructional and administrative information, accreditation data, financial applications and fiscal reports, staff inservice, technical assistance, and other information. |
| | | 1HS3. Establish an Instructional Television Allotment. | a. Districts will receive public broadcasting and other instructional television services for supplemental course enrichment, teacher assistance, and other information. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase *(continued)* | State *(continued)* | 1HS4. Establish a mechanism by which districts, education service centers, and the state can select and procure specific brands and upgrades of computer-based equipment for instruction and management and can stipulate service, training, and other technical and non-technical standards. Mechanisms include (1) arrangements with the State Purchasing and General Services Commission, (2) revision of TEC 21.901, (3) establishment of a Buyers' Cooperative, and/or (4) specifications prepared by the Texas Education Agency. | a. Districts will acquire technologies appropriate for local needs at lowest available cost. |
| | | 1HS5. Establish a State Board of Education Advisory Committee on Technology Standards to advise the Board on quality, technical, functional, security, service, and other standards by consulting with developers and educators in Texas and other states and by other means. | a. State standards for technology development, use, and security will be clearly articulated and uniform, so that the instructional, management, and inservice needs for technology in Texas will be met through the development of appropriate and high-quality products and applications and so that electronic communications will be efficient and secure. |
| | | 1HS6. Adopt standards for hardware. | |
| | | 1HS7. Add "technological systems" to TEC 16.004. | a. Computer-based technologies will be distributed equitably throughout the state.<br>b. Districts will acquire technologies appropriate to meet local needs and State Board of Education Equipment Targets. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase *(continued)* | Education Service Centers | 1HE1. Establish and maintain Technology Preview Centers. | a. Districts will be able to investigate and select technologies appropriate to meet local needs. |
| | | 1HE2. Assist districts in hardware selection. | |
| | Districts | 1HD1. Prepare, review, and revise annual district and campus plans for technology purchase and integration. | |
| | | 1HD2. Procure and integrate hardware according to plans and State Board of Education Targets. | a. Districts will acquire technologies appropriate to meet local needs and State Board of Education Equipment Targets as follows:<br>• Student access to workstations will increase from 1 hour per week, on the average, in 1988-89 to 1.3 hours per week, on the average, in every district, in 1991-92. This access time increases the student:workstation ratio from 30:1 to 23:1. Students enrolled in computing courses required for the Advanced Program will have access 10 hours per week, yielding a ratio of 3:1. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase *(continued)* | Districts *(continued)* | 1HD2. Procure and integrate hardware according to plans and State Board of Education Targets. *(continued)* | • Faculty will have access to workstations an average in every district of 2 hours per week. This access time yields a teacher: workstation ratio of 20:1.<br><br>Faculty will have access to portable workstations an average of 1.3 hours per week. This access time yields a teacher:portable workstation ratio of 30:1.<br><br>• Administrators and staff will have access to workstations an average of 2.7 hours per week. This access time yields a personnel:workstation ratio of 15:1. Sixty percent of administrators will have access to laws, rules, and judicial decisions and interpretations on CD-ROM or other mass data retrieval means.<br><br>• The percentage of districts with Local Area Networks (LANs) will increase from 5 percent in 1988 to 100 percent in 1992 so that intra-district communications will be increasingly efficient and cost effective.<br><br>• Seventy-five percent of campuses that need Telecommunications Centers or other means for receiving instruction and inservice by distance will receive these services.<br><br>• Twenty percent of districts will have Open-access Learning Centers for parent education, job training, adult literacy, and other community education programs. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Courseware Adoption and Provision | State | 1CS1. Amend textbook adoption procedures and rules to include courseware. | a. Electronic media materials will increasingly supplement, be incorporated into, and/or constitute textbooks and will be provided to districts following textbook adoption and distribution procedures. |
| | | 1CS2. Reconstitute and consider implementation of the recommendations of the Commissioner's Advisory Committee on the Operation of the Texas Textbook System to review the adoption process in light of adoption of courseware. Areas that warrant attention include reduction of the adoption cycle, incorporation of board standards in proclamations, criteria for members of the Textbook Adoption Committee, filing of sample copies, provision of "one book for each pupil enrolled (TEC 12.62)" and of learning systems "on the basis of one system for 25 students and one teacher (TAC 81.118)," and other areas. | a. The textbook adoption process will be modified to account for the differences between print and electronic instructional materials. |
| | | 1CS3. Establish a State Board of Education Advisory Committee on Technology Standards to advise the board on educational, technical, and other standards for courseware by consulting with educators and developers in Texas and other states and by other means. | a. The private sector and public education will collaborate on standards for courseware.<br>b. State standards for courseware development will be clearly articulated so that the instructional, management, and inservice needs for technology in Texas will be met through the development of appropriate and high-quality products. |
| | | 1CS4. Adopt standards for educational courseware. | |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Courseware Adoption and Provision *(continued)* | State *(continued)* | 1CS5. Approve extant courseware and software based on the recommendations of the Software Advisory Committee. | a. Districts will be informed of exemplary software so that they can acquire computer-based materials appropriate for local needs. |
| | | 1CS6. Incorporate information on courseware and other technology-related instruction into curriculum frameworks and course guidelines. | a. Guidelines for some courses in English language arts, science, mathematics, social studies, and music will provide information on computer-based and distance learning resources, textbooks and courseware, and other instructional and management materials. |
| | | 1CS7. Incorporate information on public broadcasting and other distance instruction programs into curriculum frameworks and course guidelines. | b. Curriculum frameworks in areas to be addressed during Phase 1, such as art, physical education, health education, business education, computer science, and kindergarten, will provide information on computer-based and distance learning resources, textbooks, and courseware, and other instructional and management materials. |
| | | 1CS8. Include electronic media in Proclamations 67 and 68. | a. Textbooks adopted in 1991 and 1992 in agricultural and agribusiness education, business education, computer science, driver education, fine arts, health, industrial technology, language arts, mathematics, physical science, science, social studies, and trade and industrial education will incorporate electronic media in instructional and management materials, as appropriate. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Courseware Adoption and Provision *(continued)* | State *(continued)* | 1CS9. During the scheduled review of Chapter 75, evaluate and revise curriculum rules in light of the implications of technology for the essential elements, minimum class time for promotion and graduation, and other areas affected by instructional use of technology. | a. The essential elements will be revised to include the skills needed by citizens in the next century. The description of a well-balanced curriculum, promotion and graduation requirements, and other provisions will begin to be revised to reflect the individual student progress and the continual monitoring of student achievement that are enabled by technology. |
| | | 1CS10. Investigate and, if warranted, implement state licensing and electronic delivery of software to districts for preview and instructional use. | a. Districts will be able to receive and review software appropriate for local needs at lowest available cost. |
| | Education Service Centers | 1CE1. Assist districts in software and courseware selection and use by demonstrating courseware considered for adoption in Technology Preview Centers and by training district staff. | a. Districts will acquire and use software and courseware appropriate to meet local needs. |
| | Districts | 1CD1. Provide training to staff in appropriate uses of software and courseware. | a. Districts will increasingly integrate technology-based instructional and management materials. |
| | | 1CD2. Acquire and use adopted courseware and approved and other software as appropriate to meet local instruction and management needs. | |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Training and Certification | State | **Regarding Administrators** | |
| | | 1TS1. With the Commission on Standards for the Teaching Profession and institutions of higher education, review, revise, and initiate implementation of revised standards for administrator certification to include training in the use of technology in management and instruction. | a. Administrator certification standards will include requirements for proficiency with technology so that administrators entering public schools in 1992 will be able to use and guide the use of technology in management and instruction. |
| | | 1TS2. Investigate and, if warranted, include in administrator appraisal instruments, the ability to use and to encourage the appropriate use by staff of technology for management and instruction. | a. Administrators whose management skills would increase through use of technology will be identified. |
| | | 1TS3. Investigate and, if warranted, include technology use in administrator instructional leadership training. | a. Current administrators whose growth plan includes development in technology use will be proficient in technology applications in management and instruction. |
| | | 1TS4. Train education service center and other trainers in district planning for technology in meeting the keyboarding requirement. | a. One-hundred percent of districts will have prepared technology plans and implemented initial keyboarding requirements. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Training and Certification *(continued)* | State *(continued)* | **Regarding Teachers** | |
| | | 1TS5. Review and revise preservice requirements as technologies and the integration of technology into education evolve. | a. Teachers entering public schools in 1991 will be proficient in using technology in instruction in their teaching field and in instructional management. |
| | | 1TS6. With the Texas Higher Education Coordinating Board, incorporate into the teacher induction year training in the use of technology in instruction and management, as needed. | |
| | | 1TS7. Establish summer institutes at which teachers train teachers in use of technology in instruction and instructional management. | |
| | | 1TS8. Establish requirements for certification of teachers who deliver courses by distance to Texas. | |
| | | 1TS9. Establish certification requirements for out-of-state deliverers of instruction, including instructors not certified in other states. | a. State standards for teachers will continue to be high, regardless of the location of or delivery means used by the instructor, so that teachers by distance will be at least as proficient as in-state teachers. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Training and Certification *(continued)* | State *(continued)* | **Regarding School Boards** | |
| | | 1TS10. Establish school board member training in technology as a foremost State Board of Education priority. | a. Forty percent of school boards will have participated in technology training so that local policymakers will appreciate the role and implications of technology in education. |
| | | **Regarding Use of Technology in Training** | |
| | | 1TS11. Using public broadcasting and other distance delivery means, train trainers, teachers, and other regional and local staff in appraisal, legislative and regulatory requirements, and other topics as needed. | a. Uniformity and timeliness of statewide training in a variety of areas will increase. |
| | | 1TS12. Establish a State Board of Education Advisory Committee on Technology Standards to advise the board on standards for workstation training materials. | a. State standards for workstation-based training will be clearly articulated so that needs for training in hardware use and technology integration will be met through the development and dissemination of high-quality and appropriate materials. |
| | | 1TS13. Adopt standards for workstation training materials. | |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | | OUTCOMES |
|---|---|---|---|---|
| Training and Certification *(continued)* | Education Service Centers | 1TE1. | Core services of regional education service centers include assistance to districts in technology. The assistance should include training teachers, administrators, and other staff in hardware, delivery systems, software, and courseware selection and use, in meeting the keyboarding requirement, in appraising administrators' and teachers' use of technology, as appropriate, in additional areas of administrator instructional leadership training related to technology, in teacher induction year training in technology, and in other areas consistent with district technology plans; and training school board members in technology applications for education. To carry out the core services, regional education service centers will: | a. District staff and local policymakers will be trained to perform technology-related responsibilities. |
| | | 1TE2. | Employ at least 1 full-time equivalent responsible for technology support to districts. | a. Regional Education Service Centers will provide an average of 32 hours per month of technology inservice. |
| | Districts | 1TD1. | Train induction-year teachers in technology use, as needed. | a. Entering teachers will gain familiarity with technology in the school setting. |
| | | 1TD2. | Include in teacher appraisal, as appropriate, effectiveness of teachers' use of technology. | a. Teachers' and administrators' skills in using technology instruction and management will increase. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Training and Certification *(continued)* | Districts *(continued)* | 1TD3. During required inservice days and for Advanced Academic Training, provide teacher inservice in technology planning and use and other topics, based on district and campus technology plans and teacher appraisals. | |
| | | 1TD4. Include technology planning and use in administrator appraisal, instructional leadership training, and growth plans, as appropriate. | a. The time that administrators spend on scheduling, budgeting, preparing inventories, and other tracking and paperwork duties will be reduced by 25 percent. |
| | | 1TD5. Provide incentives for teachers, administrators, and staff to participate in training. | |
| | Institutions of Higher Education | 1TI1. Develop and provide course work in technology use for preservice administrators and teachers based on state standards. | a. Course work that meets state standards for administrator and teacher certification will be provided so that administrators entering public schools in 1990-91 will be proficient in using and guiding the use of technology in instruction and management. |
| | | 1TI2. Include technology use in subject-area courses, as appropriate. | a. Undergraduate and graduate subject-area courses will increasingly incorporate technology in teaching and learning so that graduates, including teachers, will be increasingly proficient in the use of technology. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Delivery Systems | State | 1DS1. Cooperate with other state agencies and institutions of higher education in Texas on the investigation of and decisions regarding statewide telecommunications systems. | a. Telecommunications systems at the state level and throughout the education system will be efficient. |
| | | 1DS2. Coordinate telecommunications systems for instruction, inservice, and electronic mail with PEIMS and the Automated Information Telecommunications Council. | |
| | | 1DS3. Establish a statewide electronic information transfer system (TEA-NET) by providing to each district a computer, modem, telecommunications software, limited on-line time, and training and by arranging for a delivery vehicle through establishing state standards, consulting with experts, evaluating the extent of state ownership of the system, and reviewing proposals from a variety of bidders. Establish procedures for replacing postal service with electronic delivery to districts of documents under a specified length. | a. A statewide electronic information transfer system will be established so that all districts, education service centers, and the Texas Education Agency will improve communications and reduce paperwork by electronically sharing instructional and administrative information, accreditation data, financial applications and fiscal reports, staff inservice, technical assistance, and other information. Once the system is established, the state will save up to an estimated $2 million annually on communications with districts. |
| | | 1DS4. Establish an Instructional Television Allotment. | a. Districts will receive public broadcasting and other instructional television services for supplemental course enrichment, teacher assistance, and other information. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Delivery Systems *(continued)* | State *(continued)* | 1DS5. Expand integrated telecommunications systems by building on public broadcasting and other existing distance learning mechanisms. | a. Seventy-five percent of campuses that need Telecommunications Centers or other means for receiving approved course work for credit, supplemental instruction, inservice, technical assistance, parent and community education, and other information by distance will receive these services. |
| | | 1DS6. Adopt quality, technical, functional, security, service, and/or other standards for delivery systems. | a. State standards for delivery systems' installation, use, and security will be clearly articulated so that the instructional, management, and inservice needs for technology in Texas will be met through the development of appropriate and high-quality products and applications and so that communications will be efficient and secure. |
| | | 1DS7. Investigate and, if warranted, implement state licensing and electronic delivery of software to districts for preview and instructional use. | a. Districts will be able to receive and review software appropriate for local needs at lowest available cost. |
| | | 1DS8. Investigate telecommunications activities in and collaborate with other states and with federal efforts in transmitting software, programming, and other information. | a. State telecommunications activities will complement and cooperate efficiently with those in other states and at the national level. |
| | | 1DS9. Use distance delivery systems to train regional and local staff in appraisal, legislative and regulatory requirements, and other topics. | a. A minimum of 420 hours per month of inservice by distance will be provided statewide.<br>b. Uniformity and timeliness of statewide training will increase. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Delivery Systems *(continued)* | Education Service Centers | 1DE1. Train district staff in use of delivery systems. | a. District staff will be trained in using and integrating distance instruction and in using telecommunications systems for information exchange. |
| | Districts | 1DD1. Use the electronic information transfer system for statewide and intradistrict communications. | a. Administrators in all districts will electronically receive documents under a specified length from the Texas Education Agency and communicate rapidly with other districts and education service centers.<br>b. Seventy-five percent of campuses that need Telecommunications Centers or other means for receiving instruction and inservice by distance will receive these services.<br>c. The time that teachers and administrators spend on paperwork duties will be reduced by 25 percent. |
| | | 1DD2. Based on district and campus technology plans, install Telecommunications Centers and other means for receiving distance delivery of instruction and inservice. | a. One-hundred percent of teachers and 33 percent of students will be able to search selected databases. |
| | Institutions of Higher Education | 1DI1. Cooperate with state agencies in Texas on the investigation of and decisions regarding statewide telecommunications systems. | a. Telecommunications systems at the state level and throughout the education system will be efficient. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Research and Development | State | 1RS1. Provide funding for and establish the Center for Educational Technology by seeking partners, appointing a board of directors, developing by-laws, selecting a site through a bidding process, and setting priorities for research and development programs. | a. Through cooperation among the state, school districts, institutions of higher education, other public sector representatives, and the private sector, hardware, courseware, and other products that meet Texas educational needs and standards will be developed and marketed.<br><br>b. Research on the effects and effectiveness of technology-infused education will be conducted and disseminated so that products and practice will improve.<br><br>c. Through the value added by business and industry members of the Center, the quality, diversity, and competitiveness of educational technology products and applications will expand. |
| | | 1RS2. Establish short-range (one- and two- year), mid-range (three-year), and long-range (at least four-year) demonstration programs.<br><br>Use results of short-range demonstration programs to plan requests for expansion of successful programs to the 72nd Legislature, additional demonstration programs, state standards for hardware, courseware, and training, and relevant regulations. | a. A minimum of ten demonstration programs in a variety of content areas, grade levels, and school types and using a variety of technologies will be undertaken.<br><br>b. Successful uses of technology in education will be expanded to multiple district and statewide use.<br><br>c. Unproductive uses of technology will be reduced. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | | OUTCOMES |
|---|---|---|---|---|
| Research and Development *(continued)* | State *(continued)* | 1RS2. | *(continued)* Disseminate results of demonstration programs to districts, education service centers, the Center for Educational Technology, the State Board of Education Advisory Committee on Technology Standards, other states, and the public. | |
| | | 1RS3. | Review district and campus plans for technology during accreditation visits. | a. Districts will receive technical assistance in technology planning. |
| | | 1RS4. | Annually survey installed base of computers and other technologies and district intentions to expand installed base. | a. Data for planning and decisionmaking will be available. |
| | | 1RS5. | Review the process for and implementation of the *Long-Range Plan for Technology* and report to the State Board of Education and the legislature on the equity of the distribution and use of technology and on effects on achievement and efficiency. | a. The Texas Education Agency, education service centers, and districts will be accountable for implementation of the *Long-Range Plan for Technology*, depending on legislative support.<br>b. The *Long-Range Plan for Technology* will be monitored and regularly revised based on interim progress and research results. |
| | Education Service Centers | 1RE1. | Disseminate results of demonstration programs and train accordingly. | a. Districts will receive research results and technical assistance on effective uses of technology. |

## PHASE 1: 1988-1989 through 1991-1992, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | | OUTCOMES |
|---|---|---|---|---|
| Research and Development *(continued)* | Districts | 1RD1. | Participate in the Center for Educational Technology, as appropriate. | a. Hardware and courseware that meet local educational needs and standards will be developed. |
| | | 1RD2. | Represent local needs on the State Board of Education Advisory Committee on Technology Standards, as appropriate. | |
| | | 1RD3. | Participate in demonstration programs, as appropriate. | a. Emerging technologies and applications will be tested in public school settings. |
| | | 1RD4. | Incorporate the results of demonstration programs in planning, policymaking and decisionmaking, and practice. | a. Successful uses of technology will proliferate. |
| | Institutions of Higher Education | 1RI1. | Participate in the Center for Educational Technology. | a. Public schools, institutions of higher education, and the private sector will cooperate so that research is conducted and disseminated on effective uses of technology in education. |
| | | 1RI2. | Participate in establishing, supporting, and evaluating demonstration programs. | |
| | | 1RI3. | Conduct research and disseminate results of research on educational uses of technology. | |
| | | 1RI4. | Incorporate research results into preparation of educators. | |
| | Center for Educational Technology | 1RC1. | Establish organization and initiate research projects. | a. A minimum of four product development and research projects will be initiated for value-added development and marketing. |





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# PHASE 2: 1992-1993 through 1995-1996

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase | State | 2HS1. Maintain the Technology Equipment Allotment; increase or decrease the annual per-ADA allotment, as appropriate. | a. Computer-based technologies will be distributed equitably throughout the state.<br>b. Districts will be able to phase in new equipment, meet State Board of Education Equipment Targets, and alter facilities as required by the integration of technology. |
| | | 2HS2. Review the procedures established during Phase 1 by which districts, education service centers, and the Texas Education Agency procure equipment and revise as appropriate. | a. Districts will continue to acquire technologies appropriate for local needs at lowest available cost. |
| | | 2HS3. Continue to adopt quality, technical, functional, security, and service standards for hardware and other standards, based on the recommendations of the State Board of Education Advisory Committee on Technology Standards and results of research provided by the Center for Educational Technology, demonstration programs, and others. | a. Technology products that meet Texas standards will continue to be developed and marketed. |
| | Education Service Centers | 2HE1. Expand Technology Preview Centers.<br>2HE2. Continue to assist districts in hardware selection. | a. Districts will continue to be able to investigate and select among new technologies and products to meet local needs. |
| | Districts | 2HD1. Revise annual district and campus plans for technology. | a. Districts will phase in new technologies, integrating them throughout the curriculum and expanding applications in inservice and management. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Hardware Procurement and Purchase *(continued)* | Districts *(continued)* | 2HD2. Continue to procure and integrate technology according to plans and State Board of Education Equipment Targets. | a. Districts will acquire technologies appropriate to meet local needs and State Board of Education Equipment Targets, as follows:<br>• Students will have access to workstations 5 hours per week, on the average, in every district. This access time yields a student: workstation ratio of 6:1.<br>• Faculty will have access to workstations 15 hours per week, on the average, in every district. This access time yields a teacher: workstation ratio of 2.6:1. Faculty will have access to portable workstations an average of 10 hours per week, yielding a ratio of 4:1. Management outcomes include: 90 percent of teachers' time will be spent on instructional tasks.<br>• Administrators and staff will have access to workstations an average of 15 hours per week. This access time yields a personnel: workstation ratio of 2.6:1.<br>• Eighty percent of districts will have Open-access Learning Centers for parent education, job training, adult literacy, and other community education programs.<br>• Eighty-five percent of campuses will be able to receive instruction and inservice by distance technologies. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Courseware Adoption and Provision | State | 2CS1. Review incorporation of electronic media materials into textbook development, adoption, and distribution procedures and revise regulations accordingly. | a. Textbooks will incorporate or constitute electronic media, as appropriate. |
| | | 2CS2. Review courseware standards and procedures for adopting courseware standards and revise them accordingly. | a. Courseware that takes full advantage for education of the capabilities of emerging technologies will be developed and marketed for distribution to school districts. |
| | | 2CS3. Annually review and recommend software for approval, and, by 1993, review the procedures of the Software Advisory Committee; revise procedures accordingly. | a. Districts will continue to be informed of exemplary software. |
| | | 2CS4. Continue to incorporate information on courseware and other technology-related instruction into curriculum frameworks and course guidelines. | a. Curriculum frameworks in English language arts, science, mathematics, social studies, and music will provide information on computer-based and distance learning resources, textbooks and courseware, and other instructional and management materials. |
| | | 2CS5. Continue to incorporate information on public broadcasting and other distance instruction programs into curriculum frameworks and course guidelines. | |
| | | 2CS6. Include electronic media in Proclamations 69-72. | a. Textbooks adopted through 1996 will incorporate electronic media in instruction and management materials, as appropriate. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Courseware Adoption and Provision *(continued)* | State *(continued)* | 2CS7. During the scheduled revision of Chapter 75, evaluate and revise curriculum rules in light of the implications of technology for curriculum content, promotion and graduation requirements, and other areas affected by instructional use of technology. | a. Provisions for curriculum content and for delivery, promotion, and graduation will continue to be revised to emphasize the skills needed by citizens in the next century and to encourage individual student progress and maximum achievement. |
| | | 2CS8. Review licensing and electronic delivery of software, if initiated in Phase 1, and revise accordingly. | a. Districts will receive software appropriate for local needs at lowest available cost. |
| | Education Service Centers | 2CE1. Continue to assist districts in software and courseware selection and use. | a. Districts will continue to acquire and use software and courseware appropriate to meet local needs. |
| | Districts | 2CD1. Continue to provide training to staff in appropriate use of software and courseware. | a. Districts will continue to integrate technology-based instructional and management materials. |
| | | 2CD2. Continue to acquire and use adopted and other courseware and approved and other software as appropriate to meet local instruction and management needs. | |
| Training and Certification | State | 2TS1. Review certification program standards in regard to technology for administrators and revise accordingly. | a. Preservice and employed administrators will be able to use technology in management responsibilities and to support appropriate use by staff of technology in instruction and management so that communications and decisionmaking will improve in efficiency and quality. |
| | | 2TS2. Review administrator appraisal instruments for inclusion of the ability to use and to encourage the appropriate use by staff of technology for management and instruction and revise the instruments accordingly. | |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Training and Certification *(continued)* | State *(continued)* | 2TS3. Review the provision of inservice in technology to administrators and revise accordingly. | |
| | | 2TS4. Review the preparation of induction-year teachers to use technology, as needed, and revise accordingly. | a. Entering teachers will be proficient in the use of technology. |
| | | 2TS5. With the Commission on Standards for the Teaching Profession, investigate and, if warranted, revise the standards for approval to emphasize general education and professional education components, focusing on integration of technology use into teacher preservice education. | |
| | | 2TS6. Investigate and, if warranted, include effectiveness of technology use in the Texas Teacher Appraisal System instrument. | a. Employed teachers will be increasingly skilled in the use of technology. |
| | | 2TS7. Review standards for workstation training materials and revise accordingly. | |
| | | 2TS8. Review standards for certification of deliverers of instruction by distance and revise accordingly. | a. Teachers by distance will continue to be at least as proficient as in-state teachers. Instruction by distance will continue to be at least as effective as traditional instruction, when the availability of qualified on-site teachers is limited, and will continue to improve. |
| | | 2TS9. Expand state delivery of inservice by distance. | a. Teachers, administrators, and staff will receive uniform and timely inservice training in a variety of areas. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | | ACTIONS | | OUTCOMES |
|---|---|---|---|---|---|
| Training and Certification *(continued)* | Education Service Centers | 2TE1. | Train district staff in technology, software, and courseware selection and use. | a. | District staff and policymakers will perform technology-related responsibilities with assurance and quality. |
| | Districts | 2TD1. | Continue to train induction-year teachers in technology use, as needed. | a. | Entering teachers will be proficient in the use of technology. |
| | | 2TD2. | Include in teacher appraisal, as appropriate, effectiveness of teachers' use of technology. | a. | Employed teachers and administrators will be increasingly skilled in the use of technology. |
| | | 2TD3. | During required inservice days and for Advanced Academic Training, continue to provide teacher inservice in technology planning and use and other topics, based on district and campus technology plans and teacher appraisals. | | |
| | | 2TD4. | Continue to include technology planning and use in administrator appraisal, instructional leadership training, and growth plans, as appropriate. | a. | The time that administrators spend on scheduling, budgeting, preparing inventories, and other tracking and paperwork duties will be reduced by an additional 20 percent. |
| | | 2TD5. | Continue to provide incentives for teachers, administrators, and staff to participate in training. | | |
| | Institutions of Higher Education | 2TI1. | Continue to provide coursework in technology use for preservice educators based on state standards. | a. | Coursework that meets state standards for certification of professional educators will continue to be provided. |
| | | 2TI2. | Continue to include technology use in subject-area courses, as appropriate. | a. | Undergraduate and graduate subject-area courses will increasingly incorporate technology in teaching and learning so that graduates, including teachers, will be increasingly proficient in the use of technology. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Delivery Systems | State | 2DS1. Continue to cooperate with other state agencies and institutions of higher education in Texas on the investigation of and decisions regarding statewide telecommunications systems. | a. Telecommunications systems at the state level and throughout the education system will be efficient. |
| | | 2DS2. Expand integrated telecommunications systems, including public broadcasting, to support increased delivery by distance of approved coursework for credit, supplemental instruction, inservice, technical assistance information, and PEIMS data. | a. Communications and information and data exchange among education entities in Texas will be rapid and efficient. |
| | | 2DS3. Investigate and implement, as appropriate, delivery of training and instruction to homes and alternative educational settings. | a. Parents and other community members will be able to receive training and instruction at school and non-school sites. |
| | | 2DS4. Continue to use distance delivery systems to provide inservice and share information and data with districts. | a. State telecommunications activities will continue to complement and cooperate efficiently with those in other states and at the national level. The state will participate in international programming and delivery, as appropriate. |
| | | 2DS5. Continue to collaborate with telecommunications efforts in other states and at the federal level. Investigate and collaborate with appropriate international efforts. | |
| | Education Service Centers | 2DE1. Continue to train district staff in use of delivery systems. | a. District staff will be trained in using integrated telecommunications systems in instruction and information and data exchange. |
| | | 2DE2. Use the statewide information transfer system with districts and the Texas Education Agency to share information and data. | |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Delivery Systems *(continued)* | Districts | 2DD1. Continue to use the electronic information transfer system for statewide and intra-district communications. | a. The time that teachers and administrators spend on paperwork duties will be reduced by an additional 20 percent. |
| | | 2DD2. Based on district and campus technology plans, continue to install Telecommunications Centers and other means for receiving distance delivery of instruction and inservice. | a. One-hundred percent of teachers and 66 percent of students will be able to use selected databases. |
| | Institutions of Higher Education | 2DI1. Continue to cooperate with state agencies in Texas on the investigation of and decisions regarding statewide telecommunications systems. | a. Telecommunications systems at the state level and throughout the education system will continue to be efficient. |
| Research and Development | State | 2RS1. Participate in the Center for Educational Technology by coordinating state standards, determining priorities for product development, and sharing research results. | a. Through cooperation among the state, school districts, institutions of higher education, and the private sector, hardware and courseware that meet Texas educational needs and standards will continue to be developed and marketed.<br><br>b. Research on the effects and effectiveness of technology-infused education will continue to be conducted and disseminated so that products and practice will improve. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Research and Development *(continued)* | State *(continued)* | 2RS2. Based on results of demonstration programs conducted in Phase 1, establish/maintain short-range, mid-range, and long-range demonstration programs.<br><br>Use results to plan requests for additional authorizations and appropriations to the 73rd and 74th Legislatures, additional and expanded demonstration programs, state standards, and regulations.<br><br>Disseminate results of demonstration programs. | a. Successful uses of technology will be expanded statewide.<br><br>b. Technology-related regulation and legislation will be based on research results. |
| | | 2RS3. Continue to review district and campus plans for technology during accreditation visits. | a. Districts will continue to receive technical assistance in technology planning. |
| | | 2RS4. Annually survey installed base of technologies and uses at the campus and district levels. | a. Data for planning and decisionmaking will continue to be available. |
| | | 2RS5. Investigate the changes in governance, curriculum, and other areas necessitated by the integration of technology in education. | a. Revisions in the Texas Education Code and State Board of Education rules will be made so that the educational process will be continually improved by technology. |
| | | 2RS6. Continue to review the process for and implementation of the *Long-Range Plan for Technology* and report to the State Board of Education and the legislature on the equity of the distribution and use of technology and on effects on achievement and efficiency. | a. The Texas Education Agency, education service centers, and districts will be accountable for implementation of the *Long-Range Plan for Technology*, depending on legislative support.<br><br>b. The *Long-Range Plan for Technology* will continue to be monitored and regularly revised based on interim progress and research results. |

## PHASE 2: 1992-1993 through 1995-1996, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Research and Development *(continued)* | Education Service Centers | 2RE1. Continue to disseminate results of demonstration programs and train accordingly. | a. Districts will continue to receive research results and technical assistance on effective uses of technology. |
| | Districts | 2RD1. Continue to participate in the Center for Educational Technology, as appropriate. | a. Hardware and courseware that meet local educational needs and standards will continue to be developed. |
| | | 2RD2. Continue to represent local needs on the State Board of Education Advisory Committee on Technology Standards, as appropriate. | |
| | | 2RD3. Participate in demonstration programs, as appropriate. | a. Emerging technologies and applications will continue to be tested in public school settings. |
| | | 2RD4. Continue to incorporate the results of demonstration programs in planning, policy- and decisionmaking, and practice. | a. Successful uses of technology will continue to proliferate. |
| | Institutions of Higher Education | 2RI1. Continue to participate in the Center for Educational Technology. | a. Public schools, institutions of higher education, and the private sector will cooperate so that research is continually conducted and disseminated on effective uses of technology in education. |
| | | 2RI2. Continue to participate in establishing, supporting, and evaluating demonstration programs. | |
| | | 2RI3. Continue to conduct research and disseminate results of research on educational uses of technology. | |
| | | 2RI4. Continue to incorporate research results into the preparation of educators. | |

**PHASE 2: 1992-1993 through 1995-1996,** *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Research and Development *(continued)* | Center for Educational Technology | 2RC1. Expand membership and research and development projects. | a. A minimum of eight product development and research projects will be conducted.<br><br>b. Through research and generic product development conducted at the Center for Educational Technology, a minimum of five technology products will be transferred to the marketplace. |

# PHASE 3: 1996-1997 through 1999-2000

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|

NOTE: Because the trend toward merging disparate technologies is likely to continue, the Action Area categories of Hardware Procurement and Purchase, Courseware Adoption and Provision, and Delivery Systems are combined in Phase 3 under the Action Area of Technology Delivery and Content. Examples of this technological convergence that, with concerted effort, can occur in regard to education by the mid- to late-1990s include workstations that receive and present (1) voice, (2) data base and other electronically entered material, and (3) visual images, in all cases both those that are self-contained in computer, optical disc, and other storage formats as well as those that are transmitted over a distance for storage and later use or for concurrent use. Workstations are thus likely to combine the functions of the 1980s' telephone, television, telex, computer, radio, video and audio recording services, and scanners and printer.

The major responsibilities of education entities in Phase 3 that can be perceived in Phase 1 pertain to assuring that (1) applications for these technologies are developed that are appropriate for education and that meet educational goals; (2) the equipment and program content are available equitably across the state; and (3) staff are trained to use them appropriately. Policy- and decisionmaking in regard to these responsibilities must be made based on the results of the research and evaluation conducted during all three phases.

| | | | |
|---|---|---|---|
| Technology Delivery and Content | State | 3TeS1. Maintain the Technology Equipment Allotment; increase or decrease the annual per-ADA allotment, as appropriate. | |
| | | 3TeS2. Review the standard-setting process and the standards for technologies and the curriculum delivered via technology. Revise procedures of the State Board of Education Advisory Committee on Technology Standards, the Software Advisory Committee, and other groups and revise Proclamations 73-76, Chapter 75, and other curriculum-related legislation, regulations, and publications accordingly. | |
| | | 3TeS3. In cooperation with other state agencies and authorities and institutions of higher education in Texas, investigate alternative telecommunications systems for exchange and delivery of instruction, training, data, and other information to educational entities, alternative settings, and homes. Coordinate the services available from multiple vendors of technologies. | |

## PHASE 3: 1996-1997 through 1999-2000, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Technology Delivery and Content *(continued)* | State *(continued)* | 3TeS4. Assure the equitable distribution across the state of technology, instructional materials, and information needed for management that are conveyed via technology. | |
| | Education Service Centers | 3TeE1. Expand Technology Preview Centers. | a. Local decisions regarding technology selection and use will be based on expert advice. |
| | | 3TeE2. Assist districts in technology and technology-delivered instructional materials selection and use. | |
| | Districts | 3TeD1. Continue to provide training to entering and employed staff in appropriate uses of technologies for instruction and management. | |
| | | 3TeD2. Revise annual district and campus plans for technology. | |
| | | 3TeD3. Continue to acquire and integrate technologies into instruction and management according to plans and State Board of Education Equipment Targets. | a. Districts will acquire technologies appropriate to meet local needs and State Board of Education Equipment Targets as follows:<br>• Students will have access to workstations at least 7.5 hours per week, on the average, in every district. This access time yields a student:workstation ratio of at most 4:1, depending on the results of research on optimal ratios.<br>• Faculty will have access to classroom and portable workstations an average in every district of at least 30 hours per week. This access time yields a faculty:workstation ratio of at most 1.3:1. |

## PHASE 3: 1996-1997 through 1999-2000, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Technology Delivery and Content *(continued)* | Districts *(continued)* | 3TeD3. Continue to acquire and integrate technologies into instruction and management according to plans and State Board of Education Equipment Targets. *(continued)* | • Administrators and staff will have access to workstations an average in every district of 30 hours per week. This access time yields a personnel:workstation ratio of 1.3:1.<br>• Ninety percent of districts will have Open-access Learning Centers for parent and community education.<br>• All campuses will be able to receive instruction and inservice by distance technologies. |
| Training and Certification | State | 3TS1. Investigate and, if warranted, revise teacher, administrator, and other certification requirements in light of the changing governance of education and roles of personnel. | |
| | | 3TS2. Investigate and, if warranted, amend teacher exit requirements to include proficiency in using technology for instruction and management. | |
| | | 3TS3. Continue to provide inservice on multiple topics by technology. | |
| | Education Service Centers | 3TE1. Continue to train district staff in technology selection and use. | |
| | Districts | 3TD1. Continue to provide training to entering and employed staff in appropriate uses of technology for instruction and management. | |

## PHASE 3: 1996-1997 through 1999-2000, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | | OUTCOMES |
|---|---|---|---|---|
| Training and Certification *(continued)* | Institutions of Higher Education | 3TI1. | Continue to provide preservice training in technology use. | |
| | | 3TI2. | Continue to incorporate technologies into course work so that graduates are prepared to use technology in the workplace. | |
| Research and Development | State | 3RS1. | Evaluate implementation of the *Long-Range Plan for Technology* and report to the State Board of Education and the legislature on the equity of the distribution and use of technology and on effects on achievement and efficiency. | |
| | | 3RS2. | Revise the *Long-Range Plan for Technology.* | |
| | | 3RS3. | Continue to participate in the Center for Educational Technology. | |
| | | 3RS4. | Evaluate and revise other educational plans and practices as necessitated by the integration of technology in education. | |
| | | 3RS5. | Based on results of demonstration programs conducted in Phases 1 and 2 and on other research, establish/maintain short-range, mid-range, and long-range demonstration programs. Use results as basis for additional authorizations and appropriations to the 75th and 76th Legislatures, additional and expanded demonstration programs, state standards, and regulations. Disseminate results of demonstration programs. | |

## PHASE 3: 1996-1997 through 1999-2000, *continued*

| ACTION AREA | RESPONSIBLE ENTITY | ACTIONS | OUTCOMES |
|---|---|---|---|
| Research and Development *(continued)* | Education Service Centers | 3RE1. Disseminate results of demonstration programs and train accordingly. | |
| | | 3RE2. Participate in evaluation and revision of the *Long-Range Plan for Technology.* | |
| | Districts | 3RD1. Continue to participate in the Center for Educational Technology, standards-setting, and demonstration programs, as appropriate. | |
| | | 3RD2. Participate in evaluation and revision of the *Long-Range Plan for Technology.* | |
| | | 3RD3. Continue to incorporate the results of research in planning, policy- and decision-making, and practice. | |
| | Institutions of Higher Education | 3RI1. Continue to participate in the Center for Educational Technology and in demonstration programs. | |
| | | 3RI2. Continue to conduct and disseminate research and evaluation on technology in education. | |
| | Center for Educational Technology | 3RC1. Expand research and development projects. | a. A minimum of 20 product development and research projects will be conducted.<br>b. A minimum of 12 technology products will be transferred to the marketplace. |

## PHASE 3: 1996-1997 through 1999-2000, *continued*

### CUMULATIVE OUTCOMES

- Technology and its applications in education will be distributed equitably throughout Texas.
- A Long-Range Plan for Technology for the first decade of the 21st century will be prepared for implementation.
- The transition to emerging telecommunications technologies and technical standards will be accomplished efficiently.
- Professional staff employed in and entering public education will be skilled in using technology for instruction and management.
- Effective integration of technology in education will continually increase.
- Applications for education of emerging technology that meet state standards will be developed and marketed at competitive prices.

# C. Approval Process

The following approval process will be used in implementation of the Actions identified for the State in Phase 1.

1. Development of Detailed Plan

   A step-by-step plan for implementation of each action will be developed through review by appropriate groups including the State Board of Education.

2. Selection of Evaluation Criteria

   Criteria by which to evaluate project success will be identified. These criteria will be used, as appropriate, throughout the life of the project.

3. Use of Contracted Services

   As part of the Action Plan, specific projects or portions of projects may be contracted to public or private service providers. In each appropriate area, an evaluation will first be undertaken to identify the most effective and cost-efficient course. In some cases, both "in house" options and "contract" options may be fully developed to permit the best overall selection.

   For those cases where a contract option is provided, an open competition process will be used for contract awards. This process will include appropriate review of requests for proposals, evaluation criteria for awards, use of outside advisory panels, and award of substantial contracts by the State Board of Education.

# IV. REQUESTS TO THE 71ST LEGISLATURE

Based on the needs for technology—the contributions technology can make to education and to the well-being of the state—and on initial implementation of the Actions and achievement of the Outcomes, the State Board of Education requests the 71st Legislature to adopt the Public Education Technology Act of 1989. The act should include:

1. Recognition of the *Long-Range Plan for Technology of the Texas State Board of Education, 1988-2000.*

2. Authority for the appropriation of $16,650,000 for the 1990-91 biennium for initial implementation of the plan. The authority would be allocated as follows:

   2.1 Establishment of the statewide electronic information transfer system (Action 1HS2). Through provision of computer, modem, telecommunications software, limited on-line time, and training, this system would connect all districts, regional education service centers, and the Texas Education Agency for efficient and rapid electronic exchange of information, mail and bulletin boards, technical assistance, inservice, and supplemental instruction. $3,351,000

   2.2 Expansion of integrated telecommunications systems (Action 1DS5). Through arrangements for programming with public broadcasting and other deliverers and through provision of necessary hardware and training, distance learning and inservice would increase to meet the instructional needs of students and the professional needs of teachers and administrators in selected districts. $5,921,600

   2.3 Establishment of the Center for Educational Technology (Action 1RS1). A consortium of businesses and industries engaged in technology development, textbook and software publishers, public broadcasting networks, testing corporations, public educators, and institutions of higher education, the Center for Educational Technology would (1) develop prototype hardware, software, courseware, programming, and other educational technology products appropriate for schools for value-added development and marketing by consortium members, (2) encourage transfer of technology applications from industry and government to education, and (3) conduct research on the effects of technology on teaching and learning. $1,025,000

   2.4 Establishment of at least 10 demonstration programs (Action 1RS2). Demonstration programs would test technological applications in school sites and their effects on teaching, learning, and the educational environment. Programs would be developed that investigate a variety of student groups (such as at-risk, physically handicapped, and others), age groups, technologies, content areas, and other key characteristics. $1,500,000

2.5 Expansion of staff at regional education service centers (Action 1TE2). Core services of regional education service centers include assistance to districts in investigation, selection, and incorporation of hardware, courseware, and programming into education. Staff dedicated to perform these duties is needed. $2,500,000

2.6 Establishment of Technology Preview Centers (Action 1HE1). Technology Preview Centers would be established at each regional education service center at which district staff can investigate available systems and at which training and inservice can be conducted. $1,000,000

2.7 Necessary operating funds for the Texas Education Agency. $1,353,000

3. Creation of a Technology Equipment Allotment within the Foundation School Program of at least $50 per student per year for provision of hardware, courseware, and facility modification (to become effective in 1990) (Action 1HS1).

4. Creation of an Instructional Television Allotment for support of instructional television programming (to become effective in 1990) (Action 1HS3).

5. Authorization of the Center for Educational Technology (Action 1RS1).

6. Authorization of demonstration flexibility programs in district uses of technology.

7. Revision of "one book for each pupil enrolled" in Texas Education Code 12.62(g) (Action 1CS2).

8. Revision of arrangements with the State Purchasing and General Services Commission to ensure districts' abilities to select and purchase hardware appropriate for local educational needs (Action 1HS4).

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Note: The following references include only those cited in the plan.


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## COMPLIANCE STATEMENT

### TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, U.S. Department of Education.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

### TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.

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